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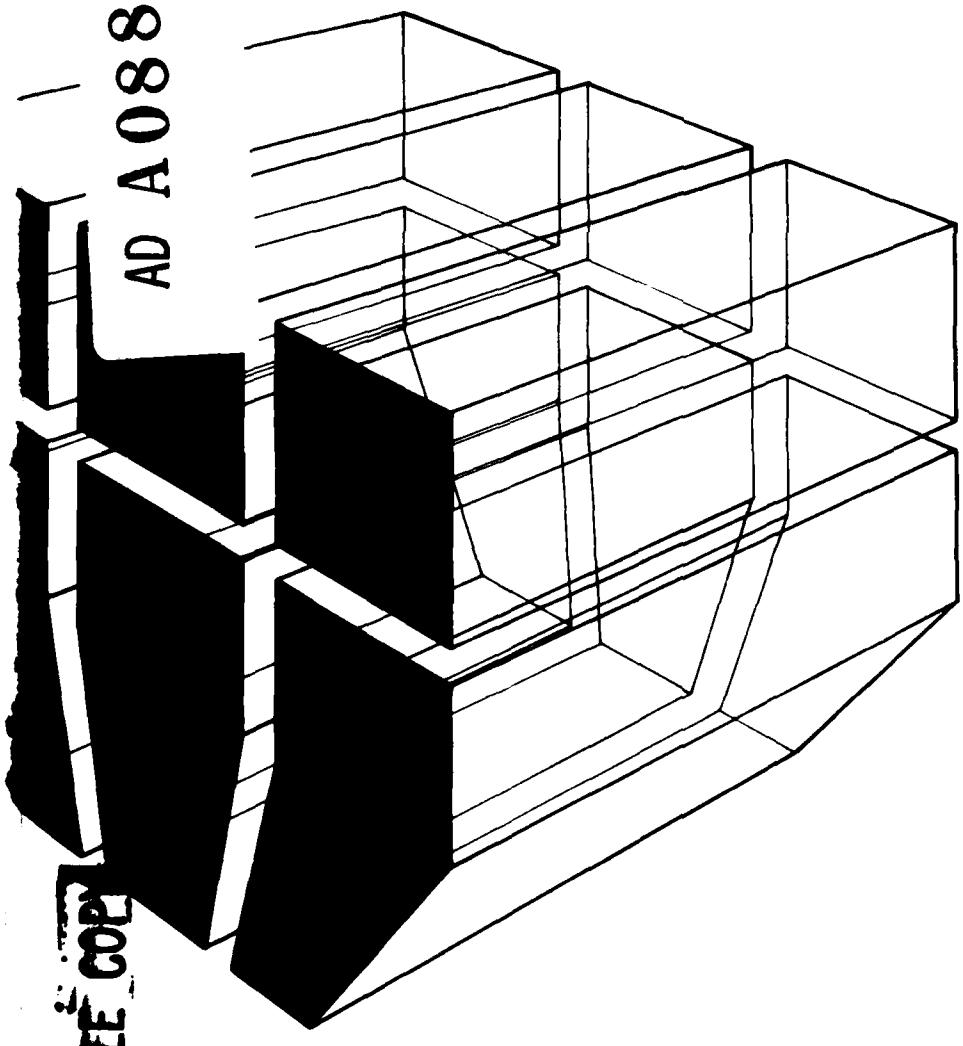
TECHNICAL REPORT N-95
August 1980

ECOLOGICAL BASELINE—FORT HOOD, TEXAS



by
W. D. Severinghaus
R. S. Baran
R. E. Riggins

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents ecological baseline information on the biota of Fort Hood, TX. Surveys were conducted in fall 1978 and spring 1979 on the terrestrial and aquatic flora and fauna for the purpose of helping Fort Hood personnel more accurately determine the environmental impacts of their military training and related activities. Representative terrestrial communities were surveyed for vertebrates (mammals, birds, reptiles, and amphibians) and vegetation. Representative aquatic communities were sampled for periphyton, phytoplankton, zooplankton, macrophytes, macroinvertebrates, and fish. Data

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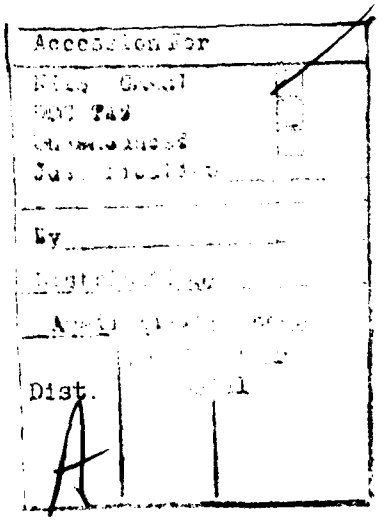
gathered are in the form of species lists, species composition, density, and/or relative abundance.



EXECUTIVE SUMMARY

Fort Hood Military Reservation encompasses approximately 87 800 ha (339 square miles; 217,000 acres) in Bell and Coryell Counties in central Texas. The major activity on the reservation is the training of the Armored Corps and its support units.

This report presents the results of ecological investigations on the reservation in late summer and early fall 1978 and spring 1979. The major purpose of the studies was to describe baseline ecological conditions of Fort Hood to determine the environmental impacts of Fort Hood activities.

Major components of the terrestrial and aquatic ecosystems were systematically sampled and analyzed. Studies of the terrestrial ecosystems included the delineation and characterization of vegetational communities. This included quantification of vegetational components of representative communities and preparation of floristic species lists. In addition, representative communities were characterized according to their wildlife components. This included preparation of species lists for all terrestrial vertebrates and bird and mammal censuses in representative habitats. Representative aquatic communities were sampled for periphyton, phytoplankton, zooplankton, macrophytes, macroinvertebrates, and fish. Each aquatic system was characterized by species composition, density, and/or relative abundance.

The reservation lies in the southern portion of the "Cross Timbers and Prairies Vegetation Area," a region encompassing most of 29 counties in North Central Texas. The reservation is geographically near two other major vegetational areas: the Blackland Prairie immediately to the east, and the Edwards Plateau about 80 km to the southwest.

The reservation is about 38 percent grassland and savanna, 57 percent woodland and scrub, and 5 percent built-up land. The woody vegetation of the reservation is primarily Ashe juniper (Juniperus ashei), live oak (Quercus fusiformis), and Texas oak (Q. texana). The grassland of the reservation includes elements of tall grass prairie, which is characteristic of the higher rainfall areas of the Blackland Prairie to the east, and the more important short-grass grasslands to the west.

Floristic surveys of Fort Hood revealed 380 species or varieties of plants representing 81 families. Two species deserve particular attention: the big-tooth maple (Acer grandidentatum), and the white dog-tooth violet (Erythronium albidum). Big-tooth maple occurs in several disjunct populations in the Owl Creek Mountain area of eastern Fort Hood. This species, having a mass range from northern Mexico to Wyoming, normally occurs in the trans-pecos area. Besides the Fort Hood populations, the nearest known natural stand is in western Bandera County, 240 km southwest of the reservation. The white dog-tooth violet population, in eastern Fort Hood, appears to be on the extreme western limits of its natural range, which extends from northeast Texas to Minnesota, Ontario, and Georgia. The disjunct populations of big-tooth maple and white dog-tooth violet do not represent threatened or endangered species.

Like the vegetation, the wildlife is typical of the Edwards Plateau. Qualitative and quantitative field surveys at Fort Hood revealed 28 species of amphibians and reptiles, 128 species of birds, and 20 species of mammals. The most notable bird species observed were the Roseate Spoonbill (Ajaia ajaja), the Osprey (Pandion haliaetus), and the Peregrine Falcon (Falco peregrinus). The spoonbill is a normal coastal species and a late summer or fall straggler in north central Texas. The Peregrine Falcon and Osprey are endangered species which are rarely observed as migrants in the Fort Hood area.

Riparian woodland provides the best habitat for bird species diversity. Species diversity was lowest in the grazed grassland census area. Densities of birds were greatest in riparian woodland, followed by mixed woodland, juniper woodland, and grassland. The bird encountered over the widest portion of the survey area during the road-cruise censuses was the Cardinal (Cardinalis cardinalis).

Common mammal species observed on the reservation included the raccoon (Procyon lotor), white-tailed deer (Odocoileus virginianus), and black-tailed jack rabbit (Lepus californicus). Trapping indicated that the deer mouse (Peromyscus maniculatus) was the most common small mammal in the fall, and the Texas mouse (Peromyscus attwateri) and White-ankled mouse (Peromyscus pectoralis) were most common in the spring.

Several species of mammals and birds are hunted on the reservation, and therefore represent an important recreational and economic resource. These include white-tailed deer, squirrels, rabbits, furbearers, Bobwhite, Mourning Dove, Turkey, and waterfowl.

Several species of endangered, threatened, or peripheral wildlife species may live on the reservation; however, only the migratory Peregrine Falcon was observed during the field surveys. One species, the Golden-cheeked Warbler, although not observed during the surveys, is considered endangered by the Texas Organization for Endangered Species (TOES) because of its breeding requirements. Its breeding range is restricted to suitable mature juniper habitats in Central Texas. The Army has protected much of the Golden-cheeked's habitat at Fort Hood from disturbance by limiting activities in several designated areas. The Osprey is considered endangered by TOES. This species was seen several times near Belton Lake, and Army activity does not appear to affect it.

Aquatic communities at Fort Hood were similar to those in other areas of Central Texas. Most of the stations sampled, other than those in Belton Lake, exhibited variable communities in terms of species compositions and densities. This was often the case in intermittent stream environments, where fluctuations in water level create pools or where floods drastically reduce resident populations and may considerably alter the physical habitat. During the fall field surveys, most of the streams were not flowing, due to dry weather in the area, thus creating a series of pools or ponds. Species assemblages included both open water and littoral forms as would be expected in an area exhibiting a variety of available habitats (littoral, profundal, limnetic) and a diversity of food sources (phytoplankton, detritus, organic matter). The spring sampling showed the effects on resident populations and diversity caused by habitat changes effected by the spring floods.

The results of the phytoplankton and periphyton fall and spring surveys showed that most, if not all, of the areas examined were dominated by taxa tolerant of a wide range of physiochemical conditions, including nutrient and organic loading. This situation was pronounced in lower Clear Creek (Station A) during the fall near a number of enrichment sources. Generally, however, these communities (and the densities observed) were typical of those commonly observed in the calcareous streams of central Texas. Phytoplankton densities were lower in the spring; however, the diversity of the diatoms increased due to scouring of the substrate by the spring rains.

Similar results were obtained in the zooplankton sampling program. Except possibly at Station D (Reese Creek), the results of the phytoplankton, periphyton, and zooplankton surveys did not indicate any effects resulting directly from siltation. On the other hand, the indications of moderate, widespread enrichment observed may have been due, at least in part, to nutrients entering the streams along with soil particles. Zooplankton densities were generally lower in the spring.

Belton Lake had rather distinct phytoplankton and zooplankton assemblages during both surveys. This is the normal condition, considering the vast difference in habitat between the reservoir and its tributary streams and the lack of significant recent freshwater input.

Based on phytoplankton and zooplankton data collected from 7 to 11 May 1979, flood events at Fort Hood in spring 1979 appeared to have the greatest impact on the Leon River. Slower-moving pool-like habitats, like those at Lower Cowhouse Creek and Belton Lake, appeared to be less affected by floods than some of the intermittent creeks where currents were faster and more scouring of substrates was likely to occur.

The macroinvertebrate survey showed that most stations were dominated by oligochaetes and dipterans. While this is often the case in enriched situations, these groups are also usually dominant in soft-sediment habitats. Doubtless, both conditions contributed to the large numbers and widespread occurrence of these organisms. The highest densities of oligochaetes, particularly tubificids which are characteristic of organically enriched habitats, were found at stations in Table Rock, House, and Cowhouse Creeks. All of these stations were characterized by thick layers of silty sediments over the original rocky stream beds. Densities were lower at most stations in the spring, although the silty substrate at Station J supported a more abundant oligochaete population, and total densities were higher at this station. Although dipterans were still an important group in terms of abundance, they were considerably less abundant and diverse in benthic samples than they were in the fall. However, quantitative and qualitative analyses of samples indicated that the numbers of taxa observed were not excessively low, nor were individual species densities high enough to indicate a heavily polluted situation.

The results of both fish collections, in the streams sampled and in Belton Lake, do not indicate any conditions that would be considered unusual in the types of habitat sampled. Members of the families Cyprinidae (minnows) and Centrarchidae (sunfishes) were the most commonly collected. The largest numbers of species were collected at lower Cowhouse Creek, mid Table Rock Creek, and lower Clear Creek. No species considered threatened or endangered

by the state or by the U.S. Department of the Interior are known to occur in the general area. Generally, the number of individuals was lower in the spring, which would be expected after the spring floods.

FOREWORD

This work was performed by the Environmental Division (EN) of the U.S. Army Construction Engineering Research Laboratory (CERL) for Fort Hood, TX, under IAO 319-79, dated 2 March 1979. The Fort Hood project monitor is CPT David Palmer, Environmental Programs Officer.

Epsey Huston and Associates, Inc. collected the spring aquatic data and all the fall data. The University of Oklahoma Biological Survey collected spring vegetation data.

Dr. R. K. Jain is Chief of EN. COL L. J. Circeo is Commander and Director of CERL, and Dr. L. R. Shaffer is Technical Director.

CONTENTS

TABLES

FIGURES

ECOLOGICAL BASELINE --
FORT HOOD, TEXAS

1 INTRODUCTION

Background

Fort Hood Military Reservation encompasses approximately 87 800 ha (339 sq mi; 217,000 acres) in Bell and Coryell Counties in central Texas (Figure 1). The major activity on the post is training of the Armored Corps and its support units. Facilities are available for field training, weapons firing, housing and support for personnel living on the post, and other required support activities. Industrial activities include motor vehicle repair, small arms repair, and electrical shops.

During late summer and early fall of 1978 and late spring and early summer of 1979, Espey Huston and Associates, Inc. and CERL conducted ecological investigations at Fort Hood Military Reservation. Data from these investigations produced baseline ecological data that would be helpful in determining the environmental impacts resulting from current Fort Hood activities (i.e., for use in the Overall Mission Environmental Impact Statement). The studies were designed to represent the entire reservation with particular emphasis on characteristic habitats of the various species studied. The results should also be valuable for evaluating the impacts of future Fort Hood activities; for example, the impacts of a future activity in a certain area of the reservation can be evaluated by referring to maps to determine affected habitats and by referring to appropriate habitat characterizations to determine their biotic components. Results of the first survey conducted in fall 1978 were documented in a report entitled Ecological Baseline Report, Fort Hood, Texas. This report adds the ecological data collected in spring of 1979.

Purpose

The purpose of this study is to provide ecological data for determining present and predicting future impacts of military activities on Fort Hood's environment.

Approach

Data for this study were collected through field surveys which gathered information on both terrestrial and aquatic biological communities. The surveys were initially conducted during fall of 1978 and then repeated during spring of 1979 to fill the void caused by normal seasonal occurrence of some types of biota. Terrestrial mammals, birds, reptiles, amphibians, and vegetation were surveyed, as well as periphyton, phytoplankton, zooplankton, macrophytes, macroinvertebrates, and fish. The Appendix of this report provides a detailed discussion of the types of data gathered and the methodology used in the survey.

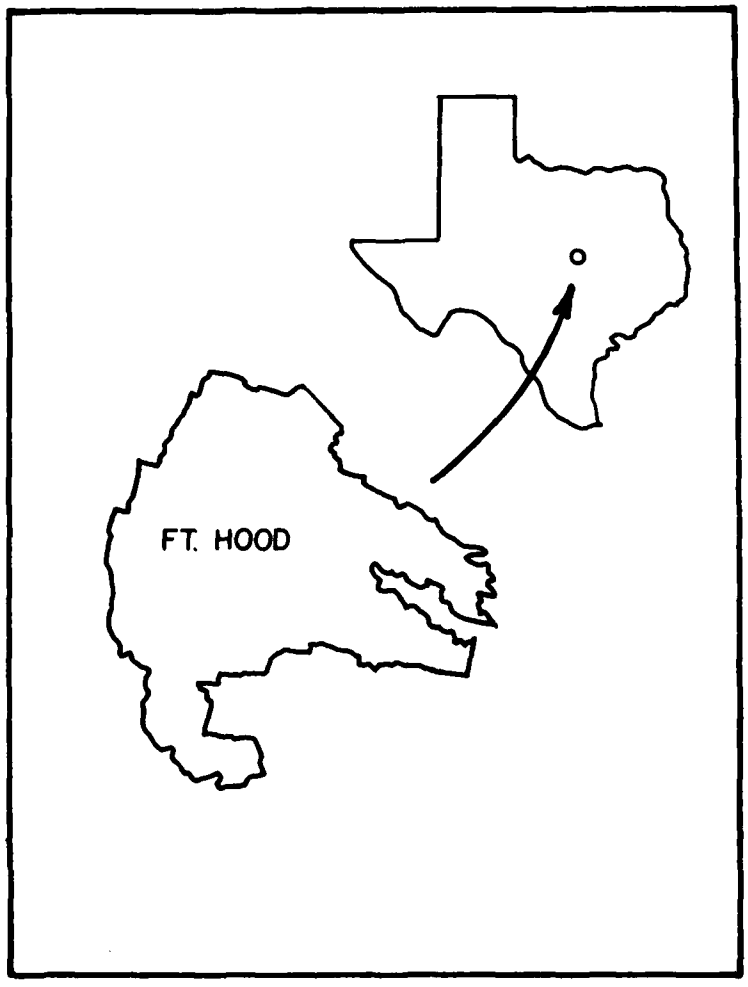


Figure 1. Location map.

Outline of Report

Chapters 2, 3, 4 present data on vegetation, wildlife, and aquatic communities; each chapter contains characterizations of representative habitats and discussions of representative and important species (i.e., recreationally important, commercially important, and threatened or endangered) for each habitat type. This material characterizes the various habitats and evaluates the importance and significance of each. Chapter 5 discusses ecologically sensitive areas and provides general conclusions. The Appendix presents methodologies used in the various surveys.

2 VEGETATION

General

Fort Hood Military Reservation lies in the "Cross Timbers and Prairies Vegetational Area," a region encompassing most of 29 counties in North Central Texas.[1] The reservation, situated in the southern portion of the area, is geographically near two other major vegetational areas: the Blackland Prairie immediately to the east, and the Edwards Plateau about 80 km to the southwest.

The woody vegetation of the reservation is most closely related to that of the eastern Edwards Plateau, as shown by the predominance of Ashe juniper (Juniperus ashei), live oak (Quercus fusiformis), Texas oak (Q. texana), cedar elm (Ulmus crassifolia), Texas ash (Fraxinus texansis), and Texas persimmon (Diospyros texana). Conversely, the two predominant tree species of the cross timbers -- post oak (Quercus stellata) and blackjack oak (Q. marilandica) -- are of minor importance on the reservation. A western tree species -- bigtooth maple (Acer grandidentatum) -- is undoubtedly the most interesting plant species on the reservation. This is a Rocky Mountain species which occurs east of the Pecos in only two other known areas: one in southwestern Oklahoma, and one which includes three counties on the southeastern Edwards Plateau.

The grassland of the reservation includes elements of tallgrass prairie, and is characteristic of the higher rainfall areas of the Blackland Prairie to the east, and of the more important mid- and short-grass grasslands to the west. Frequent fires, vehicular traffic, and overgrazing have eliminated much of the perennial grass cover over much of the area. At the time of the field survey, the apparent dominants over the majority of the grassland acreage were the broomweeds (Xanthocephalum texanum and X. dracunculoides), short, bushy, yellow-flowered annual forbs which increase enormously in response to overgrazing.[2]

The reservation is about 38 percent grassland and savanna, 57 percent woodland and scrub, and 5 percent developed land. Open grassland is most extensive where the general topography is level to gently rolling. Conversely, woodland predominates on escarpments, stream terraces, and in other areas where the terrain is rough and broken. This pattern is a natural consequence of occasional grass fires, which originate primarily from live artillery fire in the 12 222-ha (30,200 acres; 47.2 sq mi) impact area near the center of the reservation. As pointed out by Wells,[3] grasslands are maintained in areas of smooth terrain where hot, wind-blown fires are unimpeded by topographic obstacles, whereas woodlands are often restricted to rough terrain where fires burn more slowly, if at all.

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1 F. W. Gould, Texas Plants -- A Checklist and Ecological Summary (Texas A & M Univ., Texas Agric. Exp. Sta., College Station, 1975).

2 D. Correll and M. Johnston, Manual of the Vascular Plants of Texas (Texas Research Foundation, Renner, 1970).

3 P. V. Wells, "Scarp Woodlands, Transported Grassland Soils, and Concept of Grassland Climate in the Great Plains Region," Science, No. 148, pp 246-249.

Fire is a significant ecological factor in shaping the reservation's vegetational structure. Two other exogenous factors are important: (1) the off-road military traffic, including both tracked and wheeled vehicles, which causes extensive mechanical disturbance to the soil and vegetation, and (2) grazing by domestic cattle.

The following sections describe the reservation's vegetation in more detail. The information includes a discussion of the plant species observed on the reservation, a generalized vegetation map, a description of the major plant communities, and a discussion of important plant species.

Plant Species Inventory

The purpose of the floral survey was to list the vascular plant species that were flowering (or otherwise identifiable) at the time of the survey (11-15 September and 19-24 September 1978, and 22-27 May 1979). The floral survey was performed in conjunction with the vegetational survey (described in the following section) and was concentrated in 17 stands selected as being representative of the reservation. Cursory surveys were also made throughout the reservation. Nomenclature used in this inventory follows Correll and Johnston.[4]

One of the most common and conspicuous species at the Fort Hood Military Reservation was the Ashe juniper (Juniperus ashei). Because of its conspicuousness and dominance in central and west Texas, numerous common names have been applied to it, including rock cedar, post cedar, Mexican juniper, mountain cedar, and Ashe juniper. The common name Ashe juniper will be used in this report.

Table 1 gives the plant inventory taken from the survey; species are identified according to common name, scientific name, growth form, and their occurrence in upland woodlands, lowland woodlands, grasslands, and wetlands. The list includes 380 taxa (species and varieties) and 81 families. This compares with almost 5000 taxa and 166 families known to occur in Texas.[5] The largest families in the list are the sunflower family (56 taxa compared with 628 for Texas); the grass family (47 of the 672 known for Texas); the legume family (33 of 281 known for Texas); and the spurges (14 of 141 in the state). Beaty[6] has compiled a list of 584 plant taxa for central and western Bell County. The spring, early summer, and late fall inventories should produce a number of plant taxa on the reservation approaching Beaty's number.

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4 D. Correll and M. Johnston, Manual of the Vascular Plants of Texas (Texas Research Foundation, Renner, 1970).

5 F. W. Gould, Texas Plants -- A Checklist and Ecological Summary (Texas A & M Univ., Texas Agric. Exp. Sta., College Station, 1975).

6 H. E. Beaty, A Checklist of Flora and Fauna in Central and West Bell County, Texas, unpublished manuscript (3414 Forest Trail, Temple, TX, 1978a).

Plant Communities

Figure 2 is a generalized map of the vegetation at Fort Hood Reservation. The mapped categories represent the four major distinctions that can be made with respect to the vegetation of the reservation: coniferous (Ashe juniper) woodland, mixed (Ashe juniper-oak) woodland, deciduous (primarily oak) woodland, and grassland and savanna. In Figure 2, the three categories of predominantly woody vegetation are further subdivided into two canopy cover classes of less than 50 percent cover and greater than 50 percent cover. For purposes of characterizing the major categories in terms of structure and species composition, a number of representative stands were visited and sampled. Figure 3 shows the locations of the stands. Sampling methods (described in detail in the Appendix) involved both qualitative observation and objective, quantitative sampling using the point-centered quarter method of Cottam and Curtis.[7] This method allows the determination of density (number per unit area), basal area (size), and frequency (spatial distribution) of trees. From these measurements, an overall "importance percentage" can be calculated for each species as a means of indicating its relative importance in the stand. The following paragraphs describe vegetation observed at each stand. The stands are grouped under coniferous woodland, mixed woodland, and deciduous woodland. Quantitative data were collected at stands 2, 4, 8, 10, 12, and 13. Other stands are described qualitatively.

The most extensive category of woody vegetation is mixed woodland, which generally has a predominance of Ashe juniper, as well as important components of live oak, Texas oak, or both. In some small upland areas, Ashe juniper is the only significant species, while in some lowland areas, it is virtually excluded by oaks and other broadleaf deciduous trees. Some variation is present in the grassland category, which includes both open grassland and parkland (savanna). The latter consists of trees or shrubs widely scattered in a matrix of grasses and forbs.

Coniferous Woodland

The only coniferous tree species found on the reservation is Ashe juniper, the most common species on the reservation and the main component of most vegetation; however, it seldom occurs alone.

Stand 1 (Ashe juniper) occurred on rolling topography and light-colored, clayey soil. The area was grazed and had been impacted by military vehicles. Ashe juniper trees, which formed most of the woody cover, were mostly 3 to 5 m high and often had low branching trunks. Other woody vegetation in the stand included flameleaf sumac (Rhus lanceolata), Texas ash, and live oak. Grasses and broomweeds surrounded the patches of woody vegetation.

Mixed Woodland

A disjunct population of white dog-tooth violets is associated with the mixed woodland. The white dog-tooth violet population in the eastern part of Fort Hood (Figure 3), appears to be on the extreme western limits of its

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[7] G. Cottam and J. T. Curtis, 1956, "The Use of Distance Measures in Phytosociological Sampling," Ecol. 37:450-460.

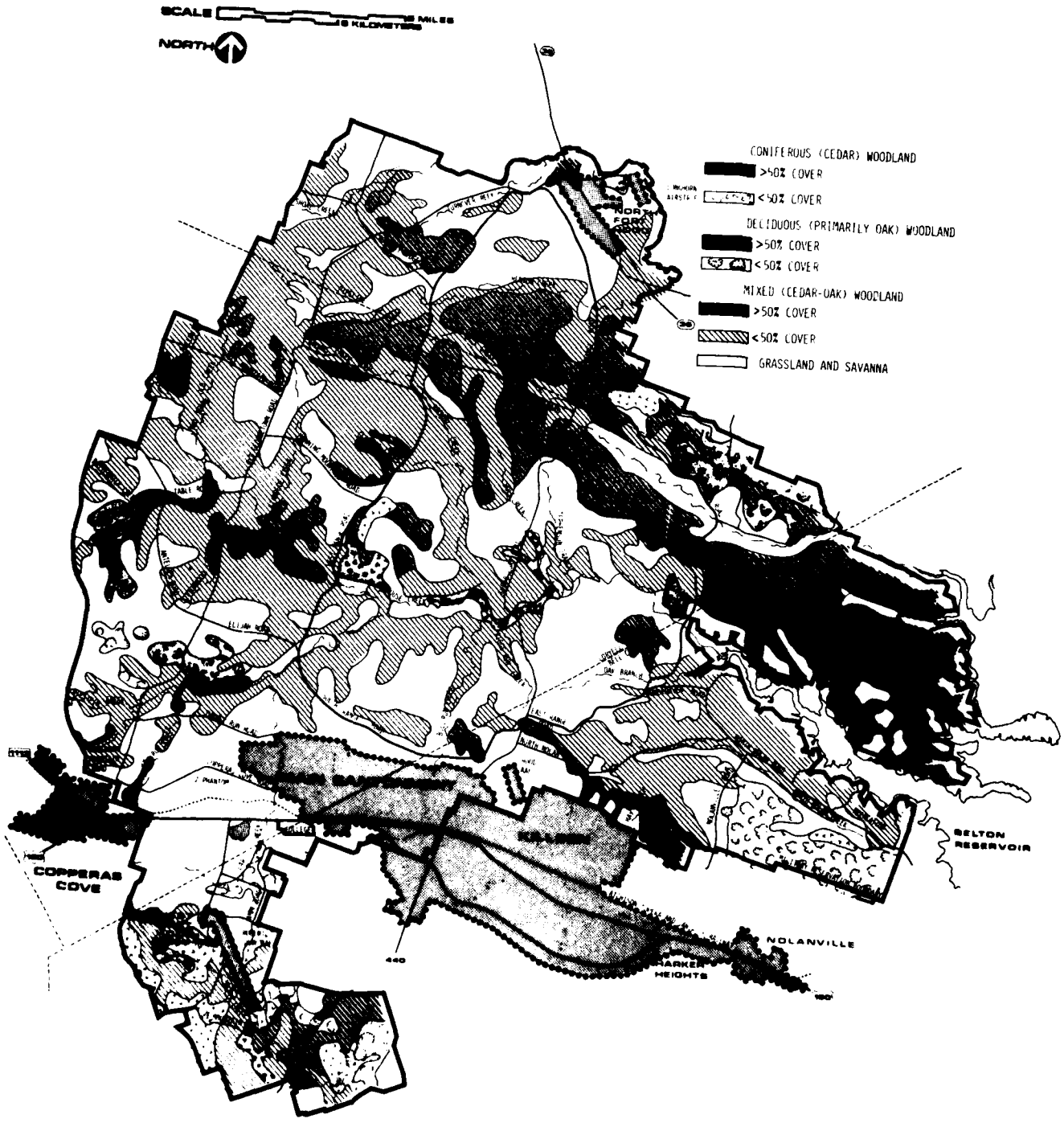

Figure 2. Vegetation map.

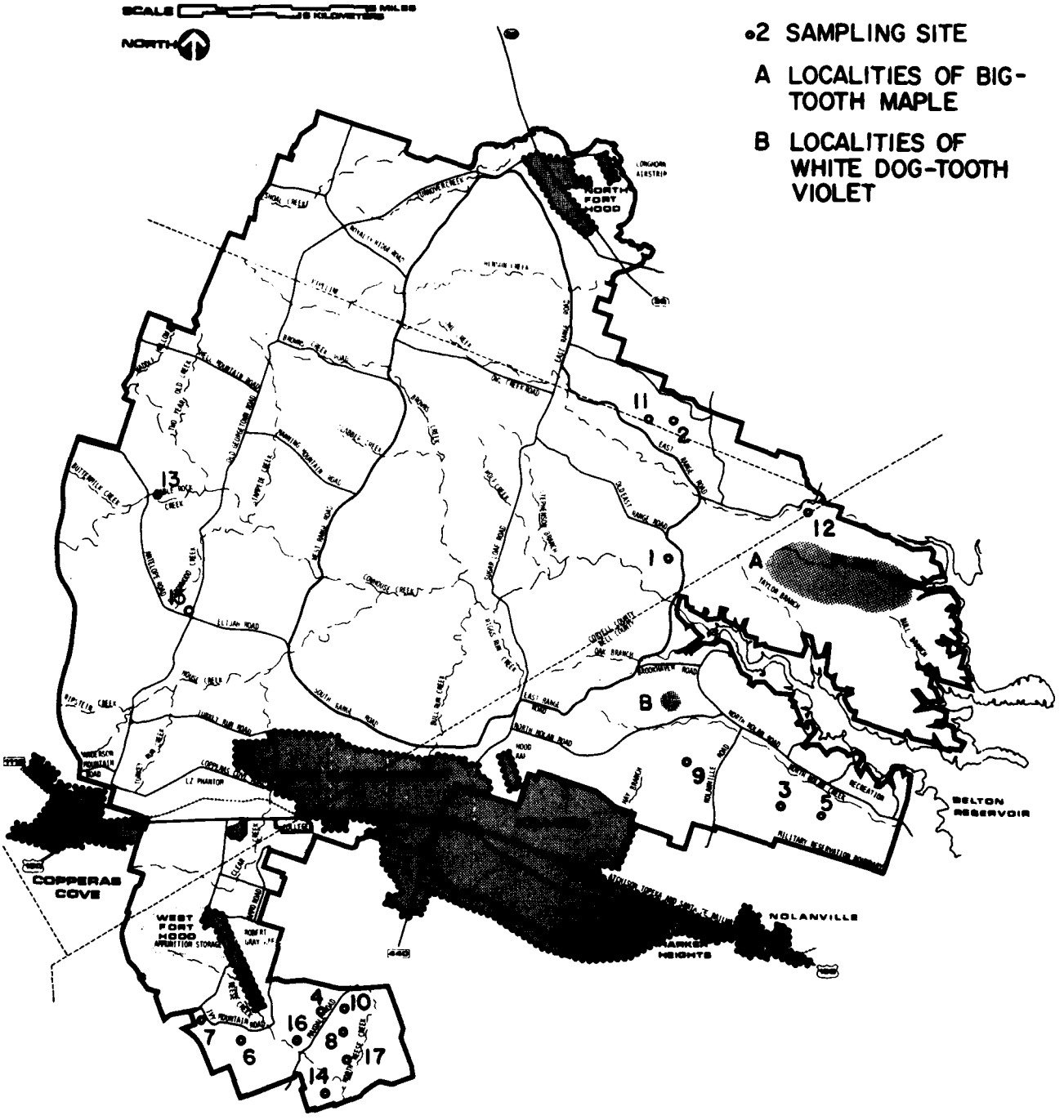

Figure 3. Vegetation sampling sites.

natural range, which extends from northeast Texas to Minnesota, Ontario, and Georgia.[8] The population is concentrated in a 15-ha area within the Oak Branch of Cowhouse Creek drainage system.[9]

Six stands dominated by Ashe juniper and oaks were examined.

Stand 2 (Ashe juniper/live oak) occurred on a 25 percent west-facing slope of rocky and sandy soil. The dominant trees were Ashe juniper and live oak (Table 2). Other woody species present were cedar elm (Ulmus crassifolia), Texas oak, and netleaf hackberry (Celtis reticulata). The total stand density was about 1800 trees per ha, and the total basal area was about 90 m^2/ha. The undergrowth, which was very dense, was composed of saplings of the canopy tree species, as well as understory trees, shrubs, and vines. Understory species were redbud (Cercis canadensis), possum-haw (Ilex decidua), Mexican buckeye (Ungnadia speciosa), and Texas persimmon (Diospyros texana). Vines included greenbrier (Smilax bona-nox) and white honeysuckle (Lonicera albiflora). Generally, the stand was disturbed, consisting of dense clumps of trees in a matrix of grasses. Common ground cover species in this stand included hairy grama (Bouteloua hirsuta), blue grama (Bouteloua gracilis), ruellia (Ruellia humilis), and painted euphorbia (Euphorbia cyathophora).

Stand 3 (Ashe juniper/live oak) occurred on level to gently rolling topography with rocky, light-colored clayey soils. The predominant tree species were Ashe juniper and live oak. Other species included Texas ash, blackjack oak, elbow-bush (Forestiera pubescens), and mustang grape (Vitis mustangensis). The trees were about 5 m high and scattered in a field of mostly broomweeds. Other ground cover species included blue grama and hairy grama.

Stand 4 (Ashe juniper/Texas oak) occurred on a 10 percent, northeast-facing slope, in an upland area of generally rolling topography. The soil was a rocky, tight, light-colored clay. The vegetation consisted of dense patches and thickets of woody vegetation scattered in a matrix of low-growing herbaceous vegetation. The dominant trees were 5-m-high Ashe junipers and Texas oaks (Table 3). Other important trees included live oak, cedar elm, buckthorn (Bumelia lanuginosa), and netleaf hackberry. The density was about 400 trees per ha, and the basal area was about 7 m^2/ha. Common understory trees and shrubs of this stand included redbud, fragrant sumac (Rhus aromatica), poison ivy (R. toxicodendron), and flameleaf sumac. Common ground cover species in this stand included buffalo grass (Buchloe dactyloides), Texas grama (Boutelou rigidiseta), hairy grama, and broomweeds.

Stand 5 (live oak/Ashe juniper) occurred atop a small mesa in a hilly, boulder-strewn area. The soil was a tight, rocky clay. The area was grazed and heavily impacted by vehicles. The dominant woody species present were 5- to 8-m live oaks and Ashe junipers. Also present were Texas ash, Texas oak, and blackjack oak. The predominant ground cover consisted of broomweeds,

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8 D. Correll and M. Johnston, Manual of the Vascular Plants of Texas (Texas Research Foundation, Renner, 1970).

9 D. Riskind, 1978, personal communication, Texas Parks and Wildlife Department, Austin.

prairie-tea (Croton monanthogynus), and Lindheimer muhly (Muhlenbergia lindheimeri).

Stand 6 (live oak-Ashe juniper) occurred in a rolling gullied area on a 10 to 15 percent north-facing slope. The soil was rocky clay, fairly tight, and light in color. Dominant woody species were live oak and Ashe juniper. A few scattered mesquites (Prosopis glandulosa) were present. Most of the area was covered with short-grass vegetation. Over a large area, the following herbaceous species were important community constituents: bermuda grass (Cynodon dactylon), little bluestem (Schizachyrium scoparium), broomweeds, buffalo grass, hairy grama, sideoats grama (B. curtipendula), seep muhly (Muhlenbergia reverchoni), and Indian grass (Sorghastrum avenaceum).

Stand 7 (live oak-Ashe juniper) occurred on rolling topography on a rocky clay soil. The dominant tree species were live oak and Ashe juniper. The rest of the area was covered by the short-grass vegetation type, consisting of hairy grama, sideoats grama, buffalo grass, silver bluestem (Bothriochloa saccharoides), little bluestem, and broomweeds.

Deciduous Woodland

Broadleaved trees (predominantly oaks) occurred in lowlands and on protected slopes and ridges. Ashe juniper occurred in these stands but was not a dominant.

A disjunct population of big-tooth maple is associated with this vegetation type. This species, which occurs in several stands in the Owl Creek Mountain area of eastern Fort Hood (Figure 3), is a trans-Pecos species with a mass range from northern Mexico to Wyoming.[10] Disjunct populations occur in canyons of the Edwards Plateau and in the Wichita Mountains of southwestern Oklahoma. The nearest known natural stand of big-tooth maple is in western Bandera County, 240 km southwest of Fort Hood.[11]

Stand 8 (live oak) occurred on a 10 percent, north-facing slope in an area of rolling topography. The soil was a rocky, chalky clay. The stand was dominated by 6-m-high live oaks (Table 4). Less important species were cedar elm, Texas oak, Ashe juniper, and netleaf hackberry. The total stand density was about 340 trees per ha, and the total basal area was about 13 m^2/ha. There were no extensive patches of trees in this vegetation type. The trees were located in long sinuous lines surrounded by short grasses. The woody understory consisting of elbow-bush and possum-haw was not extensive and tended to be disturbed. The herbaceous cover included hairy grama, Texas grama, and prairie-tea. Several Ashe junipers had been cut and removed.

Stand 9 (post oak) occurred on nearly level topography in a light-colored, tight, clayey soil. The stand was dominated by 5 to 7 m post oaks, which tended to occur singly or in small clumps and sinuous rows. The stand had been grazed and heavily impacted by vehicles in the past. Other trees,

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[10] D. Correll and M. Johnston, Manual of the Vascular Plants of Texas (Texas Research Foundation, Renner, 1970).

[11] D. Riskind, personal communication, Texas Parks and Wildlife Department, Austin (1978).

much less abundant than post oak, included buckthorn, netleaf hackberry, and Ashe juniper. The trees covered about 25 percent of the ground. Greenbrier and flameleaf sumac were common. The predominant herb was broomweed, followed by silver bluestem, prairie three-awn (Aristida oligantha), and Lindheimer muhly.

Stand 10 (cedar elm) occurred in a nearly level bottomland area with loose, sandy soils. The stand was dominated by cedar elms 5 to 10 m high (Table 5). Other tree species were Texas oak, netleaf hackberry, live oak, slippery elm (Ulmus rubra), red mulberry (Morus rubra), Mexican plum (Prunus americana), and pecan (Carya illinoinensis). The stand was relatively undisturbed. Shrubs and vines found in this stand included supple-jack (Berchemia scandens), buttonbush (Cepahlanthus occidentalis), elbow-bush, and greenbrier. The total density of the stand was about 470 trees per ha and the total basal area was about 29 m^2/ha.

Stand 11 (Texas ash-cedar elm) was a riparian stand on a tight, clayey soil. The stand was dominated by Texas ash and cedar elm, ranging from 5 to 12 m tall. Ashe juniper was third in importance, followed by Texas oak, netleaf hackberry, buckthorn, and possum-haw. The stand was not heavily disturbed.

Stand 12 (chinkapin oak/big-tooth maple) occurred on a 40 percent north-northwest-facing slope. Soils were shallow and rocky, with little humus. The dominants of the stand were chinkapin oak (Quercus muhlenbergii) and big-tooth maple (Table 6). Other trees included Texas oak, Texas ash, black walnut (Juglans nigra), and Ashe juniper. Total density was about 760 trees per ha, and basal area was about 27 m^2/ha. Common shrubs in this stand were southern blackhaw (Viburnum rufidulum), Indian-cherry (Rhamnus caroliniana), and rough-leafed dogwood (Cornus drummondii). There was very little ground cover in this stand, but purple cliff brake fern (Pellaea atropurpurea) occurred in drainage areas.

Texas ash, big-tooth maple, and Texas oak were found mainly in clumps as stump sprouts from cut trees. The smaller Ashe junipers growing under deciduous canopy cover had dead branches and were drying out as they were overtopped by other trees. A number of impressively large trees, including Ashe junipers and black walnuts, occurred in the stand. These larger trees were apparently present before the area was invaded by the current dominants. Ashe junipers (cedar) grow much more rapidly than other species so there is no species that can overtop them. Juniper seeds, carried by birds, germinate under the hardwoods and will eventually crowd out the oaks, maples and ash trees. The dead branches evidenced in this survey occurred from a lack of water. The hardwoods which have a more developed root system can sustain periods of drought much longer than immature junipers. The normal course on all sites is that the junipers are site invaders and as many as 100 immature cedars germinate under hardwoods and eventually remove enough soil moisture and nutrients to kill the hardwood. This process can be observed throughout the installation.

The ridge and mesa above the stand were dominated by large Ashe junipers and Texas oaks. Shrubs common in this area included eve's necklace (Sophora affinis), Mexican buckeye, bastard oak (Quercus sinuata var. breviloba), and evergreen sumac (Rhus virens).

The lowland forest along the stream below the stand was composed of netleaf hackberry, cedar elm, big-tooth maple, chinkapin oak, Texas ash, Ashe juniper, and pecan. Common shrubs in this stand included American beautybush (Callicarpa americana) and Indian-cherry.

This stand was generally less disturbed than other stands examined. However, on the surrounding ridges and mesas, large amounts of Ashe juniper had been cut and removed. There was also a motorcycle trail in part of this stand.

Stand 13 (pecan/elm/hackberry) occurred on loose sandy soil in a floodplain. The area had been grazed and heavily impacted by vehicles. Predominant species in the stand were pecan, cedar elm, and netleaf hackberry (Table 7). Other trees were bur oak (Quercus macrocarpa), buckthorn, Texas oak, and American elm (Ulmus americana). The total density of the stand was about 300 trees per ha, and the total basal area was about 29 m^2/ha.

The understory of the stand was best developed in the narrow draws leading to the stream along which the stand was located. Most of the understory has been eliminated under the larger trees by vehicular traffic.

Stand 14 (pecan/ash/sycamore) occurred in a rocky, clay soil along a stream. In and along the stream the most important trees were pecan, Texas ash, sycamore (Platanus occidentalis), Texas oak, and cedar elm. The main trees in the uplands near the stream were live oak and cedar elm, with only a few Ashe juniper present. Shrubs included Texas persimmon, elbow-brush, rough-leafed dogwood, and possumhaw. Common herbs along the stream were panicled tickclover (Desmodium paniculatum), canela (Pluchea purpurascens), and mist-flower (Eupatorium coelestinum).

Grassland and Savanna

Grassland on the reservation has been strongly influenced by frequent burning and/or overgrazing. The grasslands species composition ranges from tall grass prairie, which occurs in isolated fragments, to the commonly seen short and mid-grasses, to weedy annuals, which are also common. Ashe junipers were frequently scattered widely throughout the grasslands.

Stand 15 (bluestem/grama) was a mid-grass stand occurring on level terrain on tight, rocky, clay soils. The stand was grazed and heavily impacted by vehicles. Predominant species included little bluestem, hairy grama, sideoats grama, seep muhly, prairie-tea, broomweeds, and ragweed (Ambrosia artemisiifolia).

Stand 16 (bluestem/grama) occurred on similar terrain and soils. It had virtually the same species composition and the same physiognomy as Stand 15.

Stand 17 (grama/Ashe juniper) occurred on rolling, rocky topography with tight, clayey soils. The main woody species was Ashe juniper 2 to 5 m high. These trees formed about 2 percent of the total cover. Most of the cover was formed by grassland species, particularly sideoats grama, broomweeds, triple-awn (Aristida sp.), little bluestem, snow-on-the-prairie (Euphorbia bicolor), blue grama, and hairy grama.

Important Species

A species is considered important if one or more of the following criteria applies: (1) the species is commercially or recreationally valuable, (2) the species is threatened or endangered, (3) the species affects the well-being of some important species within criteria (1) or (2), or (4) the species is critical to the structure and function of the ecological system.

Threatened and Endangered Species

Ten plant species cited by the University of Texas Rare Plant Study Center as rare or endangered are known from previous collections from Bell and Coryell Counties (see Table 8). None of the species has been proposed for Federal protection under the Endangered Species Act of 1973.[12] No Federally protected species, or species proposed for protection, is known from collections in either of the two counties, according to collection information available from the Rare Plant Study Center and from the herbaria of the University of Texas, Southern Methodist University, and Texas A&M University.

Most of the 10 species flower in the spring and are therefore unlikely to be encountered or identifiable at other times of the year. The three exceptions are the southern marsh fern (Thelypteris palustris var. halenana), and the two shrubs -- spicebush (Lindera benzoin) and Texas almond (Prunus minutiflora) -- all of which would probably be identifiable during most of the growing season. Habitats that are probably capable of supporting all the species collectively do occur on the reservation.

The disjunct populations of big-tooth maple and white dog-tooth violet (Figure 4) occurring at Fort Hood do not represent threatened or endangered species. However, both populations represent significant ecological resources which could be destroyed if precautions are not taken. Riskind[13] has informed the administrators of Fort Hood of the location and importance of the populations on the reservation.

The Hedgehey Cactus (Echinocereus sp.) has been observed on Fort Hood. Due to the brief period of flowering for this genus, the individual species were not identifiable. Presently, the Federal Government recognizes as endangered three species from Texas: Black Lace Cactus (Echinocereus reichenbachii var. albertii), Lloyd's Hedgehog Cactus (Echinocereus lloydii), and Davis' Green Pitaya (Echinocereus viridiflorus var. davisii). A survey of Fort Hood should be conducted to determine these species' status.

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12 U.S. Department of Interior, Endangered and Threatened Wildlife and Plants, Fed. Reg. 41:47181 (U.S. Fish and Wildlife Service, 1976).

13 D. Riskind, personal communication, Texas Parks and Wildlife Department, Austin (1978).

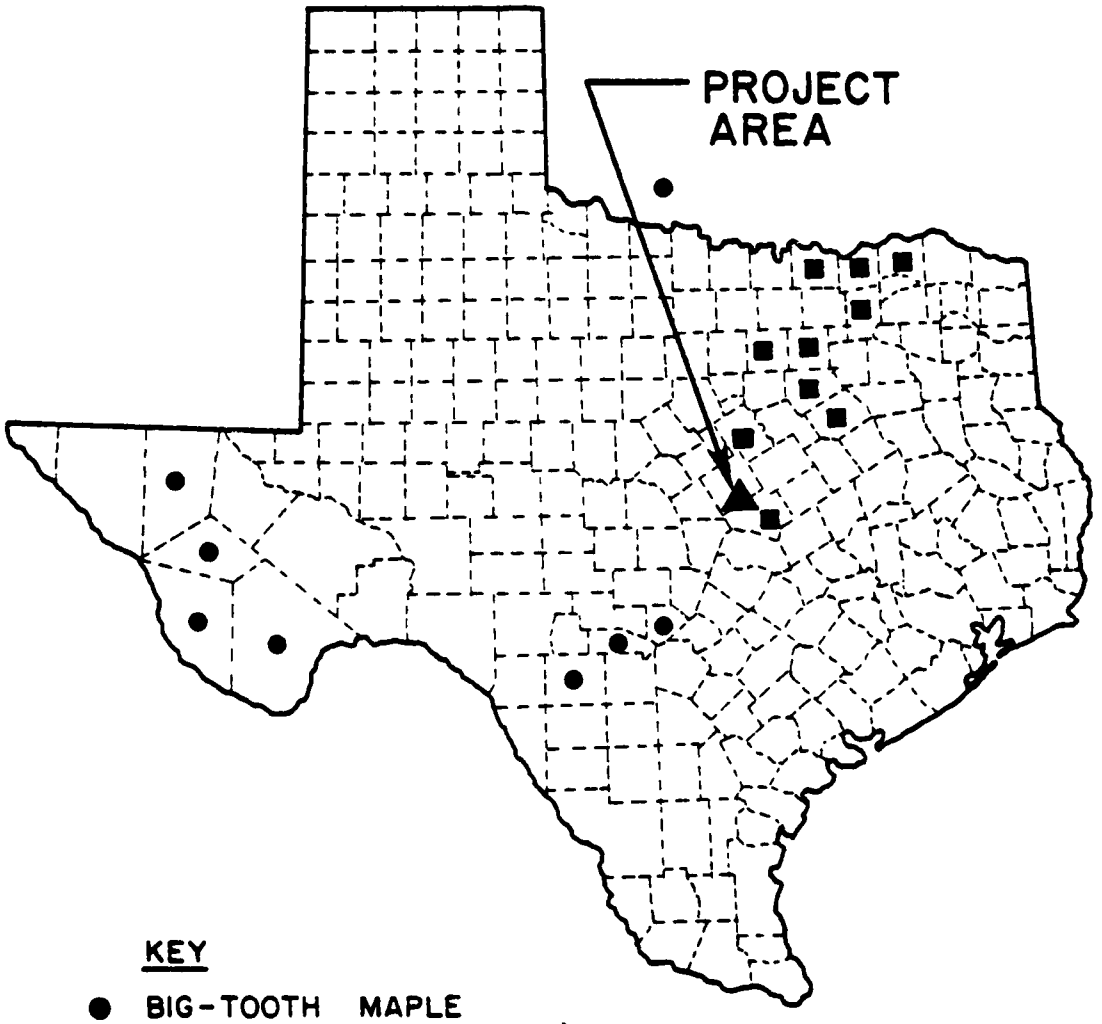

Figure 4. Distribution of big-tooth maple and white dog-tooth violet.

Commercially Important Species

The reservation is not a source of commercially important crops or wild plant species. However, grazing rights to reservation grasslands are leased to cattle ranchers in the region. In this respect, the native forage grasses could be considered commercially important. In addition, Fort Hood administrators have an agreement with a local concern (Nolan Valley Cedar Company), whereby marketable Ashe juniper (cedar) may be harvested in exchange for clearing the woody vegetation from selected old fields.

Ashe juniper vigorously invades grazing lands and reduces their livestock carrying capacity.[14] The elimination of Ashe juniper thus probably increases the carrying capacity and, correspondingly, the lease value of the reservations' grazing lands. However, the removal of Ashe juniper may reduce the amount of available nesting habitat for the Golden-cheeked Warbler, an important bird endemic to the Edwards Plateau region.

Other Important Species

Dominant species are, by definition, critical to the structure and function of the ecological system and therefore qualify as important species. The dominant species of the reservation include a number of trees and a few herbs. Removal of these species would radically alter the structure and biological productivity of the ecosystem.

Plant species important for browse and forage materials for wildlife at Fort Hood include supple-jack, post oak, American beautybush, possum-haw, greenbrier (Smilax spp.), black dalea (Dalea frutescens), and elbow-bush. Of special importance to deer are oak mast (Quercus spp.).[15]

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[14] J. Davis, personal communication, Bell County Extension Agent (1978); L. Allen, personal communication, District Conservationist, USDA Soil Conservation Service, Coryell County, Texas (1978).

[15] G. B. Alexander, Performance Report, Northeast Texas Game Management Survey (Texas Parks and Wildlife Department, 1976); G. H. Lowery, Louisiana Birds (Louisiana State Univ. Press, Baton Rouge, 1974); D. Correll and M. Johnston, Manual of the Vascular Plants of Texas (Texas Research Foundation, Renner, 1970).

Table 1

Plant Species Observed--Fort Hood

Common Name*	Family/Scientific Name	Growth Form	Upland Woodland	Lowland Woodland	Grass-lands	Wetlands
ACANTHUS FAMILY	ACANTHACEAE					
Ruellia	Ruellia humilis var. expansa	herb	X	X	X	
	Ruellia humilis var. longiflora	herb			X	
	Dyschoriste linearis	herb			X	
MAPLE FAMILY	ACERACEAE					
Bigtooth Maple	Acer grandidentatum	tree	XO			
Box Elder	Acer negundo	tree		X		
WATER PLANTAIN FAMILY	ALISMITACEAE					
	Sagittaria platyphylls	herb				X
AMARANTH FAMILY	AMARANTHACEAE					
Prostrate Pigweed	Amaranthus blitoides	herb			X	
	Amaranthus palmeri	herb			x	
AMARYLLIS FAMILY	AMARYLLIDACEAE					
Cebolleta	Cooperia drummondii	herb	XO		X	
SUMAC FAMILY	ANACARDIACEAE					
Fragrant Sumac	Rhus aromatica	shrub	XO			
Flameleaf Sumac	Rhus lanceolata	shrub	XO	O	XO	
Poison Ivy	Rhus toxicodendron	vine	XO	XO	XO	
Evergreen Sumac	Rhus virens	shrub	XO			
DOGBANE FAMILY	APOCYNACEAE					
Blue Star	Amsonia longiflora	herb			O	
HOLLY FAMILY	AQUIFOLIACEAE					
Possum-Haw	Ilex decidua	shrub	XO	XO		
MILKWEED FAMILY	ASCLEPIADACEAE					
Hierba de Zizotes	Asclepias oecotheroides	herb			X	
	Ascepias viridiflora	herb			X	
	Cynanchum barbigerum	vine	X			
	Matelea biflora	vine	X		O	
Milkweed	Asclepias asperula	herb	O		O	
Angle Pod	Matelia biflora	herb	O		O	
Climbing Milkweed	Matelia gonocarpa	vine	O			

X = Observed in Fall 1978
O = Observed in Spring 1979

*For an explanation of terminology in table headings, see the appendix.

Table 1 (Cont'd)

Common Name	Family/Scientific Name	Growth Form	Upland Woodland	Lowland Woodland	Grass-lands	Wetlands
SUNFLOWER FAMILY	ASTERACEAE					
Short Ragweed	Ambrosia artemisiifolia	herb		X	X	
Giant Ragweed	Ambrosia trifida	herb		X		X
White Sage	Artemisia ludoviciana	herb		X		
	Aster ericoidea	herb			X	
	Aster patens	herb			X	
	Aster pratensia	herb			X	
Roosevelt Weed	Baccharis neglecta	shrub		XO		
Smooth Beggarticks	Bidens laevis	herb				X
	Brickellia sp.	herb	X			
Horse-Weed	Conyza canadensia	herb		X	X	X
Yerba de Tago	Eclipta alba	herb				X
Mist-Flower	Eupatorium coelestinum	herb		X		X
	Eupatorium serotinum	herb		X		
Gumweed	Grindellia lanceolata	herb			X	
Bitterweed	Helenium amarum	herb	X		X	
Common Sunflower	Helianthus annuus	herb			X	
Maximilian Sunflower	Helianthus maximiliani	herb			X	
Grey Goldaster	Heterotheca cancacens	herb			X	
Chalkhill	Hymenopappus tenuifolius	herb			X	
Bitterweed	Hymenoxys scaposa	herb	O	O	XO	
	Iva angustifolia	herb		X	X	X
Kuhnia	Kuhnia eupatorioidea	herb			X	
	Liatris mucronata	herb			X	
Texas Skeleton Plant	Lygodesmia texana	herb			X	
Blackfort	Melampodium leucanthum var. leucanthum	herb	O		XO	
	Palafoxia callosa	herb	X	X	X	
False Ragweed	Parthenium hysterophorus	herb		X		
Crownseed Pectis	Pectis angustifolia	herb	X			
Canela	Pluchea purpurascens	herb		X		
Mexican Hat	Ratibida columnaris	herb		X	X	
White Rosinweed	Silphium albiflorum	herb			X	
Awnless Bush Sunflower	Simsia calva	herb	X			
	Solidago altissima	herb			X	
	Solidago gigantea	herb		X		
	Solidago nemoralia	herb			X	

Table 1 (Cont'd)

Common Name	Family/Scientific Name	Growth Form	Upland Woodland	Lowland Woodland	Grass-lands	Wetlands
Greenthread	Thelesperma filifolium	herb	0	0	X	
Slender Greenthread	Thelesperma simplicifolium	herb			X	
Cowpen Daisy	Verbesina encelioides	herb	X			
Frostweed	Verbesina virginica	herb	X	X		
Western Ironweed	Vernonia baldwinii	herb		X		
Woolly Ironweed	Vernonia lindheimeri	herb			X	
	Xanthium strumarium	herb		X		
Common Broomweed	Xanthocephalum dracunculoides	herb			X	
Texas Broomweed	Xanthocephalum texanum	herb			X	
Hairy Least Daisy	Chaetopappa bellidifolia	herb	0			
Engelmann Daisy	Engelmannia pinnatifida	herb			0	
Philadelpha Fleabane	Erigeron philadelphicus	herb		0		
Rabbit-Tobacco	Evax verna	herb	0	0	0	
Old Plainsman	Hymenopappus scabiosaeus	herb			0	
Bitterweed	Hymenoxys linearifolia	herb		0	0	
Dwarf Dandelion	Krigia occidentalis	herb	0			
Blazing-Star	Liatris elegans	herb	0		0	
Texas Yellow Star	Lindheimeri texana	herb	0	0	0	
False Dandelion	Pyrropappus multicaulis	herb	0	0	0	
Groundsel	Senecio imparipinnatus	herb	0		0	
Achicoria Dulce	Sonchus asper	herb		0		
BARBERRY FAMILY	BERBERIDACEAE					
Algeratis	Berberis trifoliolata	shrub	0			
BORAGE FAMILY	BORAGINIACEAE					
	Heliotropium tenellum	herb			X	
	Onosmodium bejariense	herb	X			
Puccoon	Lithospermum incisum	herb	0		0	
CACTUS FAMILY	CACTACEAE					
Hedgehog Cactus	Echinocereus sp.	shrub	X		X	
Prickly Pear Cactus	Opuntia sp.	shrub	X	X	X	
Pincushion Cactus	Coryphantha missouriensis	shrub	0			
Mound Cory	Coryphantha sulcata	shrub	0			
Lace Echinocereus	Echinocereus reichenbachii	shrub	0			
Texas Prickly Pear	Opuntia lindheimeri	shrub	0			
Brownspine Prickly Pear	Opuntia phaeacantha	shrub	0		0	

Table 1 (Cont'd)

Common Name	Family/Scientific Name	Growth Form	Upland Woodland	Lowland Woodland	Grass-lands	Wetlands
BLUEBELL FAMILY	CAMPANULACEAE					
Cardinal Flower	Lobelia cardinalis	herb				X
Venus Looking-Glass	Specularia biflora	herb	O		O	
CAPER FAMILY	CAPPARIDACEAE					
Clammy-Weed	Polanisia dodecandra	herb			X	
HONEYSUCKLE FAMILY	CAPRIFOLIACEAE					
White Honeysuckle	Lonicera albiflora	shrub	X			
Southern Black Haw	Viburnum rufidulum	shrub	X	XO		
PINK FAMILY	CARYOPHYLLACEAE					
Hilly Sandwort	Arenaria benthamii	herb				
Sleepy Catchfly	Silene antirrhina	herb				
GOOSEFOOT FAMILY	CHENOPODIACEAE					
Mexican Tea	Chenopodium ambrosioides	herb			X	
SPIDERWORT FAMILY	COMMELINACEAE					
False Day Flower	Commelinantia anomala	herb		O		
Spider Lily	Tradescantia hirsutiflora	herb			O	
MORNING GLORY FAMILY	CONVOLVULACEAE					
Bindweed	Convolvulus equitans	vine		X	X	
Dodder	Cuscuta glabrior var. glabrior	vine			X	
Morning Glory	Ipomoca trichocarpa var. torreyana	vine				
Bindweed	Convolvulus equitans	herb	O	O		
Ojo De Vibora	Evolvulus nuttallianus	herb	O		O	
DOGWOOD FAMILY	CORNACEAE					
Rough-leaf Dogwood	Cornus drummondii	shrub	XO	XO		X
ORPINE FAMILY	CRASSULACEAE					
Yellow Stonecrop	Sedum nuttallianum	herb	O			
Texas Stonecrop	Sedum pulchellum	herb	O			
MUSTARD FAMILY	CRUCIFERAE					
	Rorippa sessiliflora	herb		X		
Paniquesillo	Capsella bursa-pastoris	herb	O			
Whitloe-Grass	Draba platycarpa	herb	O		O	
Peppergrass	Lepidium densiflorum	herb	O	O	O	
Lax Bladderpod	Lesquerella gracilis	herb	O		O	
	Myagrum perfoliatum	herb			O	
Virginia Sibara	Sibara virginica	herb	O			
GOURD FAMILY	CUCURBITACEAE					
Buffalo-Gourd	Cucurbita foetidissima	herb			X	
Globe Berry	Ibervillea lindheimeri	vine	O			

Table 1 (Cont'd)

Common Name	Family/Scientific Name	Growth Form	Upland Woodland	Lowland Woodland	Grass-lands	Wetlands
CYPRESS FAMILY	CUPRESSACEAE					
Rock Cedar	Juniperus ashei	tree	XO			
SEDGE FAMILY	CYPERACEAE					
	Cyperus odoratus	herb				X
	Eleocharis sp.	herb				X
Western Umbrella Sedge	Fuirena simplex	herb				X
Littletooth Sedge	Carex microdonta	herb		O		
Muhlenberg Sedge	Carex muhlenbergii	herb		O		
Cedar Sedge	Carex planostachys	herb	O	O		
Spikerush	Eleocharis montevidensis	herb		O		
EBONY FAMILY	EBENACEAE					
Texas Persimmon	Diospyros texana	shrub	XO			
Common Persimmon	Diospyros virginiana	tree	X			
SPURGE FAMILY	EUPHORBIACEAE					
Lindheimer Copperleaf	Acalypha lindheimeri	herb			OX	
Hophornbeam Copperleaf	Acalypha ostryaefolia	herb		X		
Bull Mettle	Cnidoscolus texanus	herb			X	
Prairie-Tea	Croton monanthogynus	herb	X		X	
Texas Croton	Croton texensis	herb			X	
Snow-On-The-Prairie	Euphorbia bicolor	herb			X	
	Euphorbia cynthophora	herb	X			
Toothed Spurge	Euphorbia dentata	herb		X	X	
	Euphorbia missurica	herb			X	
Eychane	Euphorbia nutans	herb		X		
Hierba de la Colondrina	Euphorbia serpens	herb			X	
Knotweed Leafflower	Phyllanthus polygonoides	herb	O		XO	
	Stillingia texana	herb			X	
Texas Queen's Delight	Tragia ramosa	herb	O		XO	
Plateau Wild Mercury	Argythamnia simulans	herb	O			
Warty-Fruited Spurge	Euphorbia spathulata	herb	O		O	
Spurge	Euphorbia spp	herb	O		O	
Noseburn	Tragia betonicifolia	herb	O		O	

Table 1 (Cont'd)

Common Name	Family/Scientific Name	Growth Form	Upland Woodland	Lowland Woodland	Grass-lands	Wetlands
BEECH FAMILY	FAGACEAE					
Live Oak	Quercus fusiformis	tree	XO	XO		
Bur Oak	Quercus macrocarpa	tree		XO		
Blackjack Oak	Quercus marilandica	tree	XO			
Chinkapin Oak	Quercus muehlenbergii	tree		X		
Bastard Oak	Quercus sinuata var. breviloba	tree	XO			
Post Oak	Quercus stellata	tree	XO			
Texas Red Oak	Quercus texana	tree	XO	XO		
GENTAIN FAMILY	GENTIANACEAE					
Mountain Pink	Centaurium beyrichii	herb			X	
Lira de San Pedro	Eustoma grandiflorum	herb			X	
GERANIUM FAMILY	GERANIACEAE					
Cranebill	Geranium carolinianum	herb	O		O	
Alfilerillo	Erodium cicutarium	herb	O			
Stork's-Bill	Erodium texanum	herb	O		O	
IRIS FAMILY	IRIDACEAE					
Swordleaf Blue-Eyegrass	Sisyrinchium ensigerum	herb	O		O	
WALNUT FAMILY	JUGLANDACEAE					
Arizona Walnut	Junglans major	tree	XO	O		
Black Walnut	Juglans nigra	tree		XO		
CRAMERIA FAMILY	KRAMERIACEAE					
Crameria	Krameria lanceolata	herb			X	
MINT FAMILY	LABIATAE					
	Hedeoma drummondii	herb			X	
	Lycopus americanus	herb				X
Common Horehound	Marrubium vulgare	herb		X		
Lemon Beebalm	Monarda citriodora	herb			X	
Blue Sage	Salvia azurea var. grandiflora	herb		X	X	
Mealy Sage	Salvia farinacea	herb			X	
Texas Sage	Salvia texana	herb	O		XO	
	Scutellaria wrightii	herb	O		XO	
American Germander	Teuerium canadense	herb				X
Mock Pennyroyal	Hedeoma acinoides	herb	O		O	
Mejorana	Salvia coccinea	herb		O		
Drummond's Skullcap	Scutellaria drummondii	herb	O		O	
Shade Betony	Stachys crenata	herb	O			

Table 1 (Cont'd)

Common Name	Family/Scientific Name	Growth Form	Upland Woodland	Lowland Woodland	Grass-lands	Wetlands
LEGUME FAMILY	LEGUMINOSAE					
	Acacia schaffneri	shrub			X	
Bastard Indigo	Amorpha fruticosa	shrub				X
Partridge Pea	Cassia fasciculata	herb			X	
Two-Leaved Senna	Cassia roemeriana	herb			XO	
Redbud	Cercis canadensis	tree	XO			
Black Dalea	Dalea frutescens	shrub	X			
Hall Dalea	Dalea hallii	herb			X	
Illinois Bundleflower	Desmanthus illinoensis	herb			X	
Velvet Bundleflower	Desmanthus velutinus	herb			X	
Panicled Tickclover	Desmodium paniculatum	herb		X		
Kidney Wood	Eysenhardtia texana	shrub	X			
Honey Locust	Gladitsia triacanthos	tree		X		
Western Indigo	Indigofera miniata var. leptosepala	herb			X	
Prairie Clover	Lespedeza violacea	herb			X	
Slender Bush Clover	Lespedeza virginica	herb	X			
Retama	Parkinsonia aculeata	tree			X	
Roundhead Prairieclover	Petalostemum multiflorum	herb			X	
Honey Mesquite	Prosopis glandulosa	tree	O		XO	
Scurfy Pea	Psoralea tenuiflora	herb			X	
Bequilla	Sesbania macrocarpa	herb				X
Bog-Pod	Sesbania vesicaria	herb				X
Eve's Necklace	Sophora affinis	shrub	X			
Mescal-Bean	Sophora secundiflora	shrub	X			
Nuttall Milk-Vetch	Astragalus nuttallianus	herb	O		O	
Wright Milk-Vetch	Astragalus wrightii	herb		O		
Texas Bluebonnet	Lupinus texensis	herb	O		O	
Pink Mimosa	Mimosa borealis	shrub	O			
Scurfpea	Psoralea latestipulata	herb			O	
Stemless Scurfpea	Psoralea scaposa	herb	O		O	
Catclaw Sensitive Brier	Schrankia roemeriana	herb	O		O	
Texas Mountain Laurel	Sophora secundiflora	shrub	O			
Carolina Clover	Trifolium carolinianum	herb			O	
Leavenworth Vetch	Vicia leavenworthii	herb	O			
DUCKWEED FAMILY	LEMNACEAE					
Duckweed	Lemna sp.	herb				X

Table 1 (Cont'd)

Common Name	Family/Scientific Name	Growth Form	Upland Woodland	Lowland Woodland	Grass-lands	Wetlands
LILY FAMILY	LILIACEAE					
White Dog-Tooth Violet	Erythronium albidum	herb	X			
Crow-Poison	Nothoscordum bivalve	herb			X	
Cat-Brier	Smilax bona-nox	vine	X	X		
Twisted-Leaf Yucca	Yucca rupicola	shrub	X		X	
Wild Garlic	Allium canadense	herb	O			
Wild Onion	Allium drummondii	herb	O	O	O	
False Garlic	Nothoscordum bivalve	herb	O		O	
Bear Grass	Nolina texana	shrub	O			
Cat-brier	Smilax bona-nox	vine	O	O		
FLAX FAMILY	LINACEAE					
Rock Flax	Linium rupestre	herb			X	
Stiffstem Flax	Linum ridigum	herb			O	
STICK-LEAF FAMILY	LOASACEAE					
Stick-Leaf	Mentzelia oligosperma	herb			X	
LOGANIA FAMILY	LOGANIACEAE					
	Cynoctonum mitreola	herb				X
MALLOW FAMILY	MALVACEAE					
Pelotazo	Abutilon incanum	herb		X		
Spreading Sida	Sida filicaulis	herb			X	
Finger Poppy-Mallow	Callirhoe digitata	herb	O			
UNICORN-PLANT FAMILY	MARTYNIACEAE					
Unicorn-Plant	Proboscidea louisianica	herb		X		
MAHOGANY FAMILY	MELIACEAE					
Chinaberry-Tree	Melia azedarach	tree	XO	XO		
MOONSEED FAMILY	MENISPERMACEAE					
Red-berried Moonseed	Cocculus carolinus	vine	X	X		
MULBERRY FAMILY	MORACEAE					
Osage Orange	Maclura pomifera	tree	X	X		
Red Mulberry	Morus rubra	tree	X	XO		
Common Fig	Ficus carica	shrub	X			
WATER-NYMPH FAMILY	NAJADACEAE					
Common Water-Nymph	Najas guadalupensis	herb				X
FOUR O'CLOCK FAMILY	NYCTACINACEAE					
Linear-Leaf Four-O'Clock	Mirabilis linearis	herb			X	
OLIVE FAMILY	OLEACEAE					
Elbow-Bush	Foreatiera pubescens	shrub	X	X		
Texas Ash	Fraxinus texensis	tree	XO	XO		

Table 1 (Cont'd)

Common Name	Family/Scientific Name	Growth Form	Upland Woodland	Lowland Woodland	Grass-lands	Wetlands
EVENING PRIMROSE FAMILY	ONAGRACEAE					
Yellow Evening Primrose	Calylophus drummondianus	herb	O		XO	
Wild Honeysuckle	Gaura suffulta	herb			X	
	Ludwigia octovalvis subsp. octovalvis	herb				X
	Oenothera jamesii	herb				X
Missouri Primrose	Oenothera missouriensis	herb	O	O	XO	
Showy Primrose (Amopola Del Campo)	Oenothera speciosa	herb			XO	
	Stenosiphon linifolius	herb			X	
Scarlet Gaura	Gaura coccinea	herb	O	O	O	
Lizard-Tail	Gaura parviflora	herb			O	
Cut-Leaved Primrose	Oenothera grandis	herb	O		O	
Stemless Primrose	Oenothera triloba	herb			O	
WOOD-SORREL FAMILY	OXALIDACEAE					
Yellow Wood-Sorrel (Jocoyote)	Oxalis dillenii	herb		XO	O	
	Oxalis drummondii	herb			X	
POPPY FAMILY	PAPAVERACEAE					
	Argemone polyanthemos	herb			X	
PASSION-FLOWER FAMILY	PASSIFLORACEAE					
Passion-Flower	Passiflora lutea	vine		X		
POKEWEED FAMILY	PHYTOLACCACEAE					
Pigeon-Berry	Rivina humilis	herb		X		
PLANTAIN FAMILY	PLANTAGINACEAE					
Red-Seeded Plantain	Plantago rhodosperma	herb		X	X	
Wooly Plantain	Plantago patagonica	herb	O		O	
Pale-Seeded Plantain	Plantago virginica	herb	O			
PLANE-TREE FAMILY	PLATANACEAE					
Sycamore	Platanus occidentalis	tree		X		X
GRASS FAMILY	POACEAE					
Broomsedge	Andropogon virginicus	herb			X	X
Prairie Three-Awn	Aristida oligantha	herb			X	
Giant Reed	Arundo donax	herb			X	
King Ranch Bluestem	Botriochloa ischaemum var. songarica	herb			X	
Silver Bluestem	Bothriochloa saccharoides	herb			XO	
Side-Oats Grama	Bouteloua curtipendula	herb			X	
Blue Grama	Bouteloua gracilis	herb			X	
Hairy Grama	Bouteloua hirsuta	herb			X	

Table 1 (Cont'd)

Common Name	Family/Scientific Name	Growth Form	Upland Woodland	Lowland Woodland	Grass-lands	Wetlands
Texas Grama	Bouteloua rigidiseta	herb	O		XO	
Red Grama	Bouteloua trifida	herb			XO	
Japanese Chess	Bromus japonicus	herb			X	
Buffalo Grass	Buchloe dactyloides	herb	XO	X	XO	
Grassbur	Cenchrus incertus	herb			X	
Inland Sea Oats	Chasmanthium latifolium	herb		X		
Windmill Grass	Chloris verticillata	herb			X	
Bermuda Grass	Cynodon dactylon	herb		X	X	
Northern Crabgrass	Digitaria sanguinalis	herb		X	X	
Barnyard Grass	Echinochloa crusgalli	herb			X	
Canada Wild-Rye	Elymus canadensia	herb		X		X
	Etagrostia barrellieri	herb	X		X	
	Erioneuron pilosum	herb			X	
Texas Cupgrass	Eriochloa sericea	herb			X	
Lindheimer Muhly	Muhlenbergia lindheimeri	herb			X	
Seep Muhly	Muhlenbergia reverchoni	herb			X	
	Panicum texanum	herb			X	
Switchgrass	Panicum virgatum	herb		X		X
Dallis-Grass	Paspalum dilatatum	herb		X	X	
Little Bluestem	Schizachyrium scoparium	herb			X	
Green Bristlegrass	Setaria viridis	herb		X	X	
Indian Grass	Sorghastrum avenaceum	herb			X	X
Johnson Grass	Sorghum halepense	herb			X	X
Tall Dropseed	Sporobolus asper	herb			X	
Sand Dropseed	Sporobolus cryptandrus	herb				X
Purple Threeawn	Aristida purpurea	herb	0		0	
Rescuegrass	Bromus unioloides	herb	0	0	0	
Windmillgrass	Chloris andropogonoides	herb	0	0	0	
Fluffgrass	Erioneuron pulchellum	herb	0		0	
Little Barley	Hordeum pusillum	herb	0		0	
Fall Witchgrass	Leptoloma cognatum	herb	0			
Hall Panicum	Panicum hallii	herb	0		0	
Scribner's Panicum	Panicum oligosanthes	herb	0			
Carolina Canarygrass	Phalaris caroliniana	herb	0			
Texas Bluegrass	Poa arachnifera	herb	0			
Annual Bluegrass	Poa annua	herb	0			
Texas Wintergrass	Stipa leucotricha	herb	0			
Prairie Trisetum	Trisetum interruptum	herb	0		0	
Six-Weeds Fescue	Vulpia octoflora	herb	0		0	

Table 1 (Cont'd)

Common Name	Family/Scientific Name	Growth Form	Upland Woodland	Lowland Woodland	Grass-lands	Wetlands
PHLOX FAMILY	POLEMONIACEAE					
Texas Plume	Ipomopsis rubra	herb			X	
MILKWORT FAMILY	POLYCALACEAE					
White Milkwort	Polygala alba	herb	O		XO	
Rock Milkwort	Polygala tweedyi	herb			O	
KNOTWEED FAMILY	POLYGONACEAE					
	Eriogonum longifolium	herb			X	
	Persicaria densiflora	herb				X
Knotweed	Polygonum aviculare	herb				X
Pale Dock	Rumex altissimus	herb		O		
TRUE FERN FAMILY	POLYPODIACEAE					
Culantrillo	Adiantum capillus-veneria	herb				X
Little Ebony Spleenwort	Asplenium resiliens	herb				X
Purple Cliff Brake	Pellaea stropurpurea	herb	X			
Southern Shield Fern	Thelypteris kunthii	herb				X
PRIMROSE FAMILY	PRIMULACEAE					
	Samolus parviflorus	herb				X
CROWFOOT FAMILY	RANUNCULACEAE					
Leather Flower	Clematis pitcheri	vine		X		
Carolina Anemone	Anemone caroliniana	herb			O	
Tenpetal Anemone	Anemone heterophylla	herb			O	
Large Buttercup	Ranunculus macranthus	herb		O		
BUCKHORN FAMILY	RHAMNACEAE					
Supple-Jack	Berchemia scandens	vine	X	X		
Redroot	Ceanothus herbsceus	shrub	XO			
Indian Cherry	Rhamnus caroliniana	tree	XO	XO		
ROSEFAMILY	ROSACEAE					
Cockspur Hawthorne	Crataegus crus-galli	tree	X			
White Avens	Geum canadense	herb	X	O		
Mexican Plum	Prunus mexicana	tree	XO	X		
Southern Dewberry	Rubus trivialis	shrub	XO	X	X	
Japanese Rose	Rosa multiflora	shrub			O	
MADDER FAMILY	RUBIACEAE					
Common Buttonbush	Cephalanthus occidentalis	shrub		X		
	Galium circaezans	herb	X			
Prairie Bluets	Hedyotia nigricans	herb			X	
Catchweed Bedstraw	Galium aparine	herb	O			
Southwestern Bedstraw	Galium virgatum	herb	O			

Table 1 (Cont'd)

Common Name	Family/Scientific Name	Growth Form	Upland Woodland	Lowland Woodland	Grass-lands	Wetlands
CITRUS FAMILY	RUTACEAE					
Wafer-Ash	*Ptelea trifoliata*	shrub	XO			
Tickle-Tongue	*Zanthoxylum hirsutum*	shrub	XO			
Dutchman's Breeches	*Thamnosma texana*	herb			O	
WILLOW FAMILY	SALICACEAE					
Plains Cottonwood	*Populus sargentii*	tree	X	X		
Black Willow	*Salix nigra*	tree		XO		X
Cottonwood	*Populus deltoides*	tree		O		
SOAP-BERRY FAMILY	SAPINDACEAE					
Jaboncillo	*Sapindus saponaria* var. *drummondi*	tree		X		
Mexican Buckeye	*Ungnadia speciosa*	shrub	X	X		
SAPODILLA FAMILY	SAPOTACEAE					
Buckthorn	*Bumelia lanuginosa*	tree	XO	XO		
FIGWORT FAMILY	SCROPHULARIACEAE					
Prairie Agalinis	*Agalinis heterophylla*	herb			X	
Disc Water-Hyssop	*Bacopa rotundifolia*	herb				X
Narrow-Leaf Leucospora	*Leucospora multifida*	herb		X		
	Mecardonia vandellioides	herb				X
Common Mullein	*Verbascum thapsus*	herb		X	X	
Prairie Paintbrush	*Castilleja purpurea*	herb	O		O	
Cobaea Beardtongue	*Penstemon cobea*	herb	O		O	
Purslane Speedwell	*Veronica peregrina*	herb			O	
QUASSIA FAMILY	SIMAROUBACEAE					
Tree-of-Heaven	*Ailanthus altissima*	tree		X		
NIGHTSHADE FAMILY	SOLANCEAE					
Indianapple	*Datura wrightii*	herb	X			
Field Groundcherry	*Physalis viscosa*	herb	O	XO	O	
Western Horse Nettle	*Solanum dimidiatum*	herb	O		XO	
Silver Leaf Nightshade	*Solanum elacagnifolium*	herb			X	
Buffalo Bur	*Solanum rostratum*	herb		X	X	
Hairy False-Nightshade	*Chamaesaracha conioides*	herb			O	
CAT-TAIL FAMILY	TYPHACEAE					
Common Cat-Tail	*Typha latifolia*	herb				X

Table 1 (Cont'd)

Common Name	Family/Scientific Name	Growth Form	Upland Woodland	Lowland Woodland	Grass-lands	Wetlands
ELM FAMILY	ULMACEAE					
Netleaf Hackberry	Celtis reticulata	tree	XO	XO	X	
American Elm	Ulmus americana	tree		XO		
Cedar Elm	Ulmus crassifolia	tree	XO	XO	X	
Slippery Elm	Ulmus rubra	tree		X		
Sugarberry	Celtis laevigata	tree		0		
PARSLEY FAMILY	UMBELLIFERAE					
Leavenworth Eryngo	Eryngium leavenworthii	herb			X	
	Hydrocotyle verticillata var. verticillata	herb				X
Hairyfruit Chervil	Chaerophyllum tainturieri	herb	0	0	0	
NETTLE FAMILY	URTICACEAE					
Pennsylvania Pellitory	Parietaria pensylvanica	herb	0			
VALERIAN FAMILY	VALERIANACEAE					
Corn Salad	Valerianella amarella	herb	0		0	
VERVAIN FAMILY	VERBENACEAE					
American Beautybush	Callicarpa americana	shrub		X		
	Lantana scorta	shrub		X		
Texas Frog-Fruit	Phyla incisa	herb	0		XO	
Dakota Vervain	Verbena bipinnatifida	herb	0		XO	
Gray Vervain	Verbena canescens var. roemeriana	herb			X	
Texas Vervain	Verbena halei	herb		X	X	
Common Chaste-Tree	Vitex agnus-castus	shrub		X		
New Mexico Vervain	Verbena neomexicana	herb			0	
Pink Vervain	Verbena pumila	herb	0		0	
Harsh Vervain	Verbena scabra	herb			0	
MISTLETOE FAMILY	VISCACEAE					
Injerto	Phoradendron tomentosum subsp. tomentosum	shrub		X		
GRAPE FAMILY	VITACEAE					
Pepper-Vine	Ampelopsis arborea	vine	X	XO		
Possum-Grape	Cissus incisa	vine	X	0		
Virginia Creeper	Parthenocissus quinquefolia	vine	XO	XO		
Spanish Grape	Vitis berlandieri	vine	XO	XO		
Mustang Grape	Vitis mustangensis	vine	X	X		

Table 2

Structure of Ashe Juniper-Live Oak Woodland (Stand 2) -- Fort Hood

Species*	Count	Mean Basal Area (cm^2)	Density (stems/ha)	% Relative Density	Total Basal Area (dm^2/ha)	% Relative Basal Area	% Frequency	% Relative Frequency	% Importance
Netleaf hackberry	1	392	45.3	2.5	177.7	1.9	10.0	4.0	2.8
Ashe juniper	18	454	815.3	45.0	3704.7	40.1	90.0	36.0	40.4
Live oak	13	530	588.9	32.5	3116.4	33.8	90.0	36.0	34.1
Texas oak	2	554	90.6	5.0	501.6	5.4	20.0	8.0	6.1
Cedar elm	6	637	271.8	15.0	1731.5	18.8	40.0	16.0	16.6
Total	40		1811.9	100.0	9231.9	100.0	250.0	100.0	100.0

*For an explanation of terminology in table headings, see the appendix.

Table 3

Structure of Ashe Juniper-Texas Oak Woodland (Stand 4) -- Fort Hood

Species*	Count	Mean Basal Area (cm^2)	Density (stems/ha)	% Relative Density	Total Basal Area (dm^2/ha)	% Relative Basal Area	% Frequency	% Relative Frequency	% Importance
Wooly buckthorn	1	170	6.6	1.7	11.2	1.6	6.7	3.1	2.1
Netleaf hackberry	1	81	6.6	1.7	5.3	0.8	6.7	3.1	1.9
Ashe juniper	26	160	172.8	43.3	276.1	39.7	80.0	37.5	40.2
Live oak	7	330	46.5	11.7	153.3	22.0	33.0	15.6	16.4
Texas oak	22	128	146.2	36.7	187.5	26.9	73.3	34.4	32.7
Cedar elm	3	312	19.9	5.0	62.2	8.9	13.3	6.3	6.7
Total	60		398.6	100.1	695.6	99.1	213.0	100.0	100.0

*For an explanation of terminology in table headings, see the appendix.

Table 4

Structure of Live Oak Woodland (Stand 8) -- Fort Hood

Species*	Count	Mean Basal Area (cm^2)	Density (stems/ha)	% Relative Density	Total Basal Area (dm^2/ha)	% Relative Basal Area	% Frequency	% Relative Frequency	% Importance
Netleaf hackberry	1	142	8.4	2.5	11.5	0.9	10.0	11.1	4.8
Ashe juniper	1	159	8.4	2.5	13.3	1.0	10.0	11.1	4.9
Live oak	35	396	293.8	87.5	1164.5	89.9	50.0	55.6	77.7
Texas oak	1	170	8.4	2.5	14.3	1.1	10.0	11.1	4.9
Cedar elm	2	544	16.8	5.0	91.5	7.1	10.0	11.1	7.7
Total	40		335.8	100.0	1295.1	100.0	90.0	100.0	100.0

*For an explanation of terminology in table headings, see the appendix.

Table 5

Structure of Cedar Elm Woodland (Stand 10) -- Fort Hood

Species*	Count	Mean Basal Area (cm^2)	Density (stems/ha)	% Relative Density	Total Basal Area (dm^2/ha)	% Relative Basal Area	% Frequency	% Relative Frequency	% Importance
Pecan	1	117	11.7	2.5	13.7	0.5	10.0	4.2	2.4
Netleaf hackberry	5	509	58.4	12.5	297.1	10.2	40.0	16.7	13.7
Red mulberry	1	214	11.7	2.5	24.9	0.9	10.0	4.2	2.5
Mexican plum	1	207	11.7	2.5	24.2	0.8	10.0	4.2	2.5
Live Oak	2	2210	23.4	5.0	516.0	17.8	20.0	8.3	10.4
Texas oak	7	289	81.7	17.5	236.1	8.1	40.0	16.7	14.1
Cedar elm	22	617	256.8	55.0	1584.1	54.6	100.0	41.7	50.4
Slippery elm	1	1753	11.7	2.5	204.5	7.1	10.0	4.2	4.6
Total	40		467.1	100.0	2900.6	100.0	240.0	100.2	100.6

*For an explanation of terminology in table headings, see the appendix.

Table 6

Structure of Oak-Maple Woodland (Stand 12) -- Fort Hood

Species*	Count	Mean Basal Area (cm^2)	Density (stems/ha)	% Relative Density	Total Basal Area (dm^2/ha)	% Relative Basal Area	% Frequency	% Relative Frequency	% Importance
Big-tooth maple	19	187	242.3	31.7	453	16.6	73.3	26.8	25.0
Texas ash	10	185	127.7	16.7	236	8.6	53.3	19.5	14.9
Ashe juniper	5	225	63.4	8.3	143	5.2	26.7	9.8	7.8
Black walnut	2	2351	25.2	3.3	593	21.7	13.3	4.7	10.0
Chinkapin oak	14	520	178.1	23.3	928	34.0	60.0	22.0	26.4
Texas oak	10	293	127.7	16.7	375	13.7	46.7	17.1	15.8
Total	60		764.4	100.0	2728	99.8	273.3	99.9	99.9

*For an explanation of terminology in table headings, see the appendix.

Table 7

Structure of Pecan-Elm-Hackberry Woodland (Stand 13) -- Fort Hood

Species*	Count	Mean Basal Area (cm^2)	Density (stems/ha)	% Relative Density	Total Basal Area (dm^2/ha)	% Relative Basal Area	% Frequency	% Relative Frequency	% Importance
Wooly blackthorn	1	358	7.5	2.5	27	0.9	10	4.0	2.5
Pecan	18	1301	134.1	45.0	1762	59.7	90	36.0	46.9
Netleaf hackberry	8	813	60.2	20.0	489	16.6	50	20.0	18.9
Bur oak	2	562	15.0	5.0	84	2.9	20	8.0	5.3
Texas oak	1	506	7.5	2.5	38	1.3	10	4.0	2.6
American elm	1	81	7.5	2.5	6	0.2	10	4.0	2.2
Cedar elm	9	798	67.7	22.5	540	18.3	60	24.0	21.6
Total	40		299.5	100.0	2946	99.9	250	100.0	100.0

*For an explanation of terminology in table headings, see the appendix.

Table 8

Rare or Endangered Plants

Scientific Name (Common Name)*	Habitat	Flowering Time	Status	Distribution	
				Texas	North America
Arabis petiolaris (Rock cress)	Open woods, rocky knolls, wooded bluffs	April to May	1-D	Central Texas	Endemic to Texas
Carex oligocarpa[1] (Few-Seed sedge)	Wooded calcareous slopes	April to May	2/3-F(A)	Travis County Kendall County	From Ontario & N.E. U.S., W. to Mich., Ia., Mo. & Okla., S. to Ala., Ky., Ark. & Tex.
Dyssodia tagetoides (Marigold dogweed)	Dry soils	June to August	1-D(A)	N. Central Tex. S. to Bexar & Fayette Counties	Central Okla. S. to S. Cen. Tex.
Lespedeza violacea (Prairie clover)	Dry soils	July to August	2-E(A)	N. Central Tex.	Most of the N.E. & Cen. U.S.
Lindera benzoin (Spicebush)	Rich wooded slopes rock areas along streams	March to April	1-C(A)	Edwards Plateau	S.E. Va., S. to Fla. & Tex. W. to Ohio, Mich., Mo. & Okla.
Lomatium daucifolium (Prairie lomatium)	Rocky slopes, bluffs, ravines	March to April	2-C(A)	N. blackland prairies & plains country	Texas N. to S.D.
Poa arachnifera (Texas bluegrass)	Relatively undisturbed prairies	May to June	2-E(A)	Plains country, N. Cen. Tex. & Edwards Plateau	Kan., Okla., Tex., introduced Gulf States
Prunus minutiflora (Texas almond)	Limestone slopes, sandy brushy plains	March to April	1-B	Edwards Plateau Rio Grande Plains	Endemic to Tex.
Sencio glabellus (Butterweed)	Sandy soil	Spring	2-E(A)	E. Tex. (Gregg & San Augustine Counties)	S.E. U.S. N. to N.C., Ill. & Mo., W. to Kan., Okla. and Tex.
Thelypteris palustris var. haleana (Southern marsh fern)	Open sandy bogs, swamps, meadows, open low woods along streams	Fall	1-C(A)	Jefferson County Waller County Colorado County	Fla. to La., & E. Tex. N. to Pa.

[1]Texas specimens differ from those of main distribution range

Source: Rare Plant Study Center (1974) and Correll & Johnston (1970)

Comments:

1 - scarce, endangered in Texas
2 - very rare, acutely endangered in Texas
3 - presumed extinct, with no records since 1930 in Texas
A - distributed broadly but regionally in North America and extending into Texas
B - distributed over several of the vegetational areas of Texas
C - distributed in two of the vegetational areas of Texas
D - distribution limited to 4 to 8 counties in one vegetational area
E - distribution limited to 1 to 3 counties in one vegetational area
F - known only from one or a few populations; explicit information occassionally provided

*For an explanation of terminology in table headings, see the appendix.

3 TERRESTRIAL WILDLIFE

The wildlife, like the vegetation of the Fort Hood Military Reservation, is typical of the Edwards Plateau and bordering areas described by Blair.[16] In fact, Blair includes Fort Hood in the northeastern portion of the Balconian Biotic Province, which includes the Edwards Plateau (Figure 5).

The terrestrial vertebrate fauna of the Balconian Biotic Province contain a unique mixture of species from the Austroriparian, Tamaulipan, Chihuahuan, and Kansan Biotic Provinces. It also contains six endemic species of neotenic salamanders that have evolved in the subterranean waterways and springs of the Edwards Plateau, and one avian species whose breeding range lies almost entirely within the Balconian Biotic Province. Blair considered the Edwards Plateau as a separate biotic province because of its unique aggregate vertebrate fauna, the unique vegetational aspect of the region, and the fact that it is a discrete physiographic unit.

The topography of the eastern part of this province, which includes Fort Hood, is generally rugged because several rivers and their tributaries dissect the limestone. Limestone outcrops are characteristic of the stream canyons, and limestone fragments occur at the surface over most of the area. The climate of the eastern portion of the Balconian has been classified as dry subhumid and mesothermal.[17] Blair characterizes it as an area of intermediate ecological conditions between eastern forests and western deserts.

Wildlife Habitats

The Fort Hood area can be divided into several major wildlife habitats. The first division is between aquatic and terrestrial areas. Terrestrial areas are further divided into characteristic units which coincide closely with the major vegetational communities. Edges or ecotones between forested and non-forested areas and between the different types of forested areas cause a blending of species typical of the pure habitats. Many wildlife species actually prefer these ecotones (particularly those between forested and non-forested areas). This is true to some extent for recreationally important species, such as the white-tailed deer (Odocoileus virginianus), eastern cottontail (Sylvilagus floridanus), and Bobwhite (Colinus virginianus). These transition zones are preferred not only for the diversity of available food materials but also for the usually dense cover provided by the characteristic overlap of vegetational communities. Conspicuous in all habitat types are areas of physical disturbances (i.e., motorcycle trails, tank trails, burned areas). Four major wildlife habitat types were encountered in the Fort Hood area. The following sections briefly characterize these habitat types, along with lists of their characteristic faunal components. Also included is a short discussion of urban wildlife.

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16 W. F. Blair, "The Biotic Provinces of Texas," Tex. J. Sci., Vol 2 (1950), pp 93-117.

17 C. W. Thornthwaite, "An Approach Toward a Rational Classification of Climate," Geogr. Rev., Vol 38 (1948), pp 55-94.

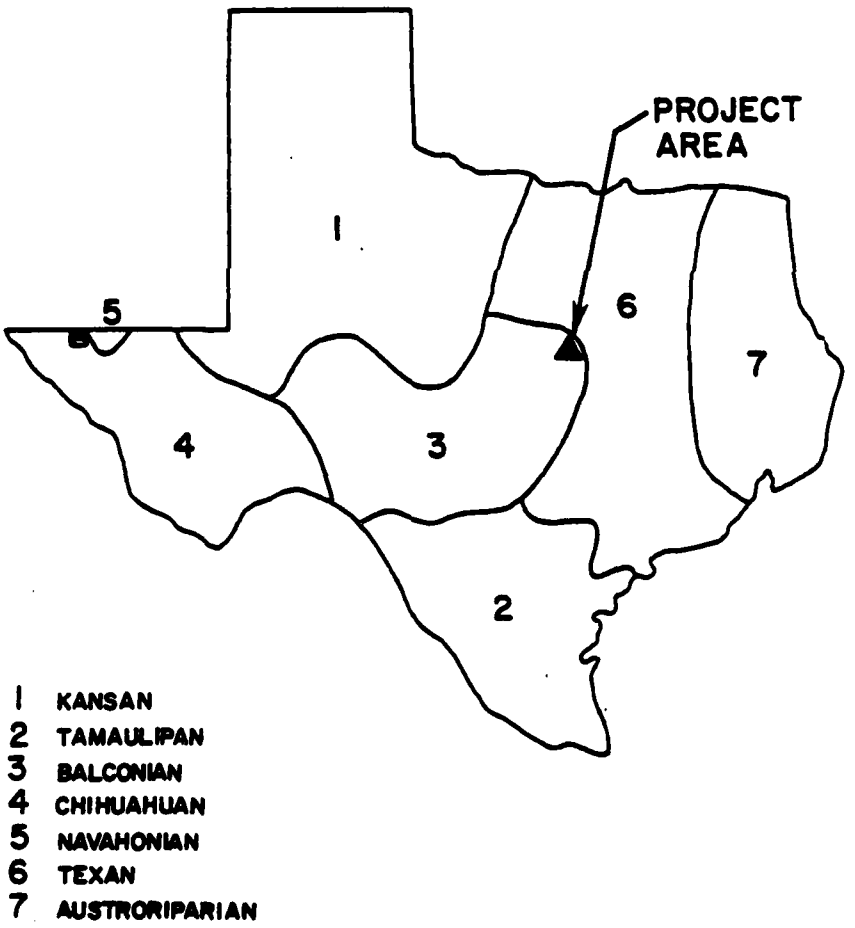

Figure 5. Biotic provinces of Texas.

Upland Woodland

The most characteristic vegetational association (and thus wildlife habitat) of the Balconian Biotic Province is a scrub forest composed of species of juniper and oaks, and other less dominant species.[18] This habitat predominates in the Fort Hood area. The physical appearance of this forest varies, depending to some extent on the amount of physical disturbance which has occurred in any given area. It also varies according to the relative abundance of the dominant species. Rather distinct subdivisions can be recognized between areas having a high density of Ashe juniper (Juniperus ashei) as opposed to areas having mostly deciduous species. Areas with high densities of large old juniper are essential as nesting habitat for the Golden-cheeked Warbler (Dendroica chrysoparia), a species whose entire breeding range is restricted to such suitable forests in Central Texas.

Vertebrate species, exclusive of fish, which are characteristic of this habitat are presented below. Those which are more characteristic of the juniper-dominated areas are marked with an asterisk.

Southern Prairie Lizard
Texas Spiny Lizard
Broad-banded Copperhead
Western Diamondback Rattlesnake
Texas Patchnose Snake
Eastern Blackneck Garter Snake*
Gray Fox
Bobcat
Eastern Woodrat
Deer Mouse
Texas Mouse
White-ankled Mouse
Nine-banded Armadillo
Mourning Dove
Cardinal
Bewick's Wren
Tufted Titmouse
Black-capped Vireo*
Golden-cheeked Warbler*
Rufous-crowned Sparrow
Painted Bunting
Ladder-backed Woodpecker
Brown Towhee
White-tailed Deer

Deciduous (Riparian) Woodland

Along the stream bottoms, canyons, and other more mesic areas are riparian forests composed mostly of live oaks, elms, hackberries, pecans, and in certain areas a Rocky Mountain species of maple. These riparian situations provide avenues for extending many Austroriparian species into the Fort Hood region. They are also prime habitat for game species such as the fox squirrel (Sciurus niger) and turkey (Meleagris gallopavo). Species typical of this habitat include:

Gray Treefrog
Four-lined Skink
Broad-banded Copperhead
Virginia Opossum
Raccoon
White-tailed Deer
Fox Squirrel
Deer Mouse
Carolina Wren
White-eyed Vireo
Black-and-white Warbler
Summer Tanager
Cardinal
Eastern Wood Pewee
Barred Owl
Screech Owl

[18] W. F. Blair, "The Biotic Provinces of Texas," Tex. J. Sci. Vol 2 (1950), pp 93-117.

Turkey
Yellow-billed Cuckoo
Scissor-tailed Flycatcher
Downy Woodpecker

Grasslands, Rangelands, and Other Open Areas

This habitat category includes open areas in which trees are either few in number or entirely absent. Ground cover varies from sparse to heavy. Species composition and densities of the herbaceous plants indicate that many areas are overgrazed to some extent by cattle. Although grazing is allowed over most of Fort Hood, it is excluded from some enclosures, including a number of fenced wildlife food plots, as well as areas such as Gray's Airfield in West Fort Hood. These areas provide better food and cover for wildlife than most of the grazed or disturbed rangeland. Species which inhabit open areas include:

Ornate Box Turtle
Texas Horned Lizard
Spotted Whiptail
Western Coachwhip
Wheat Plains Narrowmouth Toad
Couch's Spadefoot
Eastern Green Toad
Coyote
Fulvous Harvest Mouse
Hispid Cotton Rat
Texas Mouse
Black-tailed Jackrabbit
Eastern Cottontail
Nine-banded Armadillo
Turkey Vulture
Bobwhite
Red-tailed Hawk
American Kestrel
Mourning Dove
Common Nighthawk
Scissor-tailed Flycatcher
Mockingbird
Loggerhead Shrike
Eastern Meadowlark
Lark Sparrow
Field Sparrow

Springs, Streams, Ponds, Reservoirs, and Other Aquatic Habitats

This habitat category includes Belton Lake, Leon River, Cowhouse Creek, other streams and their tributaries, and numerous ponds and springs scattered over Fort Hood. Streams are mostly intermittent and seasonal; however, portions of many contain water in the form of pools throughout most of the year when the streams are not actually flowing. Ponds, streams, and other aquatic habitats are not only important to resident wildlife, such as aquatic turtles, snakes, frogs, shorebirds, and other species, but also as a source of moisture for species in the surrounding habitats, particularly during extended dry periods. They provide essential breeding habitat for several amphibian species. Migrating and wintering waterfowl also frequent these habitats. Vertebrate species (exclusive of fishes) typical of this habitat are:

Red-eared Turtle
Diamondback Water Snake
Blotched Water Snake
Redstripe Ribbon Snake
Red-spotted Toad
Eastern Green Toad
Spotted Chorus Frog
Cricket Frog
Bullfrog
Nutria
Beaver
Pied-billed Grebe
Great Blue Heron
Great Egret
Green-winged Teal
Blue-winged Teal
Spotted Sandpiper
Western Sandpiper

Plains Leopard Frog
Rio Grande Leopard Frog
Raccoon
Northern Shoveler
Belted Kingfisher
American Widgeon
Lesser Scaup

Urban Areas

Urban areas at the Fort Hood Military Reservation include North Fort Hood, West Fort Hood, and the Main Cantonment Area. Although species diversity of the urban zones may be low in comparison to natural habitats, the densities of some species are often relatively high. The avifauna of urban areas may, in fact, have higher densities than adjacent native habitats, although the species diversity is much lower.[19] The quality of urban areas as wildlife habitat depends on many factors, including the types and densities of plant species and the types of structures present. Species adapted to urban environments at Fort Hood include:

Woodhouse's Toad
Texas Brown Snake
Big Brown Bat
Raccoon
House Mouse
Black Rat
Norway Rat
Starling
House Sparrow
Rock Dove
Common Nighthawk
Chimney Swift
Purple Martin
Blue Jay
Mockingbird
Common Grackle

Wildlife Species

Quantitative and/or qualitative surveys of amphibians, reptiles, birds, and mammals were conducted during August and September 1978 and April and May 1979. An initial 2-day reconnaissance (9 to 10 August) was followed by fall wildlife surveys between 21 and 25 August and from 28 August to 1 September; an additional fall reconnaissance was made on 9 and 10 September. Spring surveys were conducted between 11 April and 3 May 1979. Seven sites were quantitatively sampled for terrestrial vertebrates (Figure 6); the Appendix describes the sampling methods used.

Amphibians and Reptiles

Table 9 lists amphibian and reptile species whose geographic range includes the Fort Hood area, their general habitat preference, and the species observed during the field surveys. Of the 79 potentially occurring species, 28 (35 percent) were actually observed. Species with eastern affinities which were observed were the Blanchard's cricket frog (Acris crepitans), gray treefrog (Hyla versicolor or H. chrysoscelis), and bullfrog (Rana catesbeiana). Other species observed which are characteristic of the Balconian Biotic Province, most of which have western affinities, include the Texas greater earless lizard (Cophosaurus texanus), collared lizard (Crotophytus collaris), spotted

[19] C. W. Sexton, personal communication, Department of Zoology, University of Texas, Austin (1978).

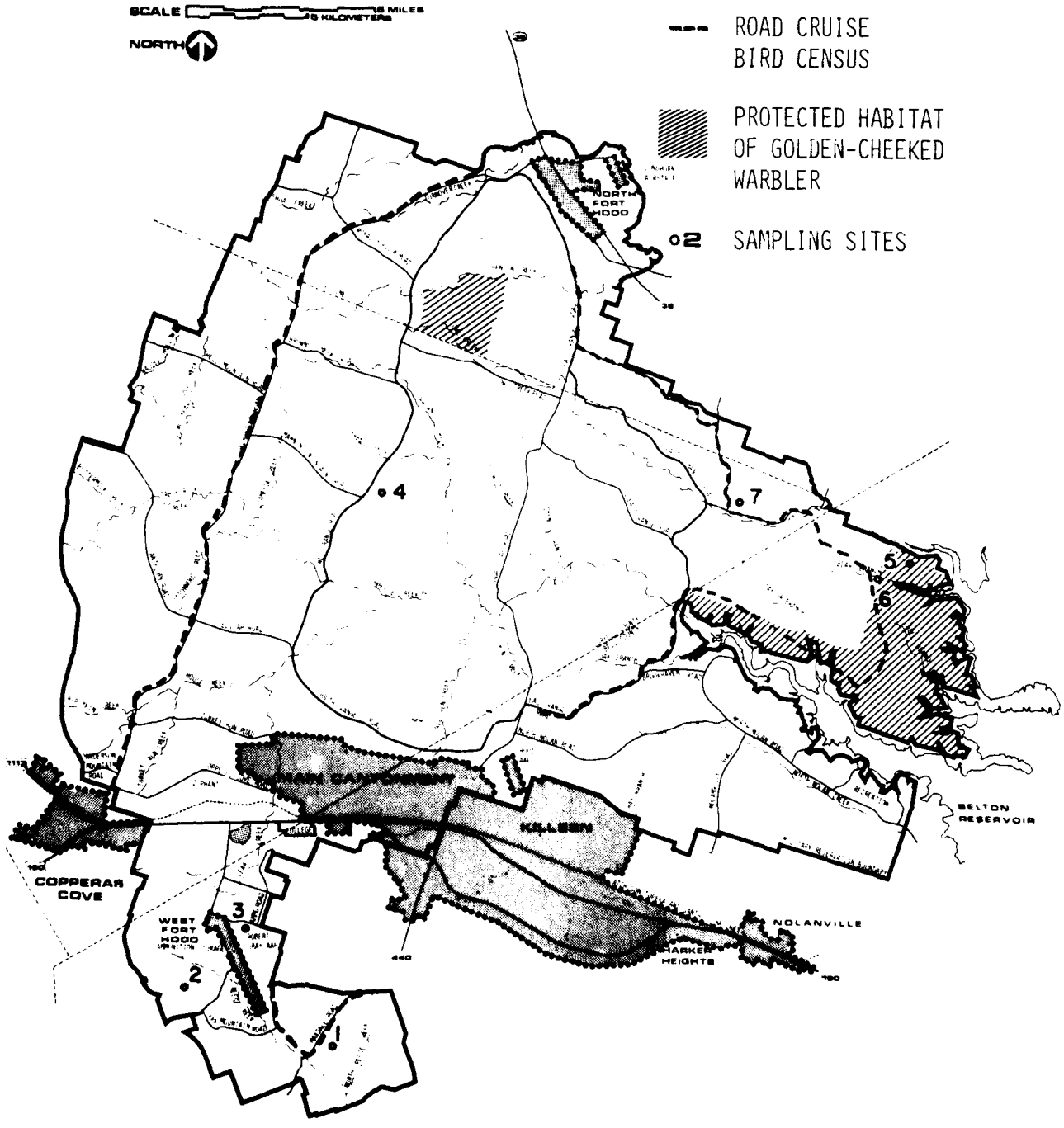

Figure 6. Wildlife sampling sites.

whiptail (Cnemidophorus gularis), great plains ground snake (Sonora episcopa), western diamondback rattlesnake (Crotalus atrox), green toad (Bufo debilis), red-spotted toad (Bufo punctatus), and great plains narrowmouth toad (Gastrophyne olivaceus). Species observed which have southern affinities include the Texas spiny lizard (Sceloporus olivaceus), four-lined skink (Eumeces tetragrammus), Rio Grande leopard frog (Rana berlandieri), and Texas patchnose snake (Salvadora grahamiae).

On 30 August 1978, researchers observed ponds containing singing green toads, red-spotted toads, spotted chorus frogs, great plains narrowmouth toads, Rio Grande leopard frogs, and Blanchard's cricket frogs. Recent rains had apparently created conditions conducive to breeding in these species.

The eastern black-necked garter snake (Thamnophis cyrtopsis) was not previously reported for Bell County by Raun and Gehlbach[20] or by Beaty;[21] however, Potter[22] reported that he had observed the species in the Fort Hood area. The single specimen observed in this survey was collected in a "cedar brake" north of Belton Lake.

Birds

Table 10 lists the avian species whose geographic ranges include the Fort Hood Military Reservation, their probable seasonal occurrence, their habitat preference, and the relative abundance of the species actually observed during the field surveys. Eighty species of birds were observed during the fall census, despite the fact that most were either in molt, not singing, or migrating silently through the area. The spring survey added an additional 47 species to the list of birds observed. The most notable species observed were the Roseate Spoonbill (Ajaia ajaja, the Osprey (Pandion haliaetus), and the Peregrine Falcon (Falco peregrinus). An immature Roseate Spoonbill was observed feeding and roosting at a drainage pond north of the Main Cantonment Area on 28, 29, and 30 August and on 9 September 1978. This normally coastal species is a late summer and fall straggler in north central Texas and has been taken four times in Oklahoma and once in Kansas.[23] It is possible that recent tropical storms in the Gulf of Mexico caused the young bird to stray from its normal range. Post-breeding wandering is common in this species, particularly among first- and second-year birds. Beaty[24] reported other recent observations of the species in the area. The Peregrine Falcon is an endangered species which is a rarely observed migrant in the Fort Hood area.

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20 G. Raun and F. R. Gehlbach, "Amphibians and Reptiles in Texas," Dallas Mus. of Nat. Hist., Bulletin 2 (1972).

21 H. E. Beaty, A Checklist of Flora and Fauna in Central and West Bell County, Texas, unpublished manuscript (3414 Forest Trail, Temple, TX, 1978a).

22 F. Potter, personal communication, Texas Parks and Wildlife Department, Austin (1978).

23 G. M. Sutton, Oklahoma Birds (Univ. of Oklahoma Press, Norman, 1967); H. C. Oberholser, The Bird Life of Texas, Vol. 1 and 2 (University of Texas Press, 1974).

24 H. E. Beaty, A Checklist of Flora and Fauna in Central and West Bell County, Texas, unpublished manuscript (3414 Forest Trail, Temple, TX, 1978a).

Beaty[25] reported one in 1976 in an area a few miles from Fort Hood. The single bird observed in this survey was seen perched in a dead tree in the Owl Creek Mountains, north of Belton Lake. In woodland habitats, the Peregrine feeds mainly on small and medium-sized birds such as goatsuckers, jays, woodpeckers, and blackbirds, while in open grassland habitats, it feeds on meadowlarks and sparrows.[26] The Osprey, which is an endangered species (see Table 21, p 87), was an adult individual seen several times in the vicinity of Bear Creek near Belton Lake.

An analysis of the Emlen transect bird census data (Tables 11 through 15) indicated species richness (Whittaker's species diversity/richness index) to be the greatest in the riparian woodland (d=4.04, Station 6) and lowest in the grazed grassland (d=1.31, Station 1). Intermediate were the deciduous/juniper woodland (d=2.37, Station 2) and the juniper woodland (d=2.20, Station 5). These results were expected, since species diversity tends to increase in relation to the habitat's complexity. The vertical aspect of a forest (particularly a tall riparian forest), provides a number of ecological niches which are lacking in open grassland habitats. The species richness in the burned mixed deciduous/juniper woodland (d=1.37, Station 4) was much lower than that of the undisturbed mixed woodland and only slightly higher than that of the grazed grassland.

The Whittaker's species diversity/richness index was not calculated for the spring data. This index requires that a study area of specific size be thoroughly searched and that all species within that area (within reasonable searching time constraints) be identified. Data for Emlen's transit bird census method are not gathered from an area of specific size, since each species has its own survey area strip width (see Table 11). Therefore, these data are not presented since they would lend credence to using those methods concurrently.

The estimated fall densities of small birds based on transect results, was 823 per 100 ha in riparian woodland, 210 per 100 ha in mixed woodland, 298 per 100 ha in juniper woodland, and 93 per 100 ha in grazed grassland (Tables 11 through 15). Density in the disturbed woodland was 305 per 100 ha; however, one species, the Cardinal (Cardinalis cardinalis), accounted for about two-thirds of the total density (Table 15). Overall, the estimated fall densities of birds in the Fort Hood area were low in comparison to estimated densities in other habitats in central and south Texas. The low density estimates could be due in part to the general inactivity of some species and to the irregularity of the daily activity patterns of others at the time of year in which the censuses were conducted.

The estimated spring densities were considerably higher than the fall densities in all habitats except the disturbed woodland. Lower densities cannot be caused by avian seasonal or daily inactivity patterns, since the Emlen transect census method, when used properly, must count all birds within the strip designated by the field personnel. Low fall densities may have been caused by the reduced availability of food, since the survey was conducted

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25 H. E. Beaty, personal communication, Temple, Texas (1978b).

26 H. C. Oberholser, The Bird Life of Texas, Vol. 1 and 2 (University of Texas Press, 1974).

toward the end of an extreme drought. The higher, more normal densities were due to the winter and spring moisture reviving the area. Densities were higher in the undisturbed woodlands, particularly those with good oak populations. Juniperus sp. and other coniferous species do not provide as much edible vegetation as oaks; therefore, populations like those at Fort Hood can be expected to be lower. Grasslands are only a single stratum and can easily be less productive for bird life, and when there is grazing, a reduction in bird populations is expected; however, just the fact that the woodlands were disturbed may account for the lower populations.

Tables 16 and 17 present the results of the road-cruise censuses. The Cardinal was the most widespread, abundant species observed during the fall and spring cruises on both the east and west sides. Other widespread species on the east side were the Mourning Dove, Carolina Chickadee, and Mockingbird. In the fall, the Lark Sparrow and Tufted Titmouse were noted, and the Eastern Meadowlark, Field Sparrow, and Brown-headed Cowbird were observed in the spring. Other widespread species on the west side were the Carolina Chickadee, Turkey Vulture, and Mockingbird in the fall, and the Tufted Titmouse, Eastern Meadowlark, Lark Sparrow, Killdeer, Mourning Dove, and Redwinged Blackbird in the spring. The most abundant birds on the east side were the Cardinal, Carolina Chickadee, Mourning Dove, and Turkey Vulture in the fall and the Cardinal, Mourning Dove, Mockingbird, Lark Sparrow, Tufted Titmouse, and Eastern Meadowlark in the spring. The most abundant birds on the west side were the Cardinal, Carolina Chickadee, and Turkey Vulture in the fall, and the Cardinal, Mockingbird, Eastern Meadowlark, Lark Sparrow, Mourning Dove, and Redwinged Blackbird in the spring.

Mammals

Table 18 lists mammals whose known geographic range includes the Fort Hood area, the habitats in which they generally occur, and the species observed at Fort Hood. Common species observed during general reconnaissance included the raccoon (Procyon lotor), white-tailed deer, and black-tailed jack rabbit (Lepus californicus) during the fall, and the raccoon, white-tailed deer, and eastern cottontail in the spring. Raccoon tracks were common in upland woodland as well as in the riparian areas, which they normally prefer. White-tailed deer were observed in a variety of habitats, although none were observed in strictly grassland areas. Black-tailed jack rabbits were observed mainly in open areas; much of Fort Hood provides good habitat for this species, which prefers overgrazed rangeland to thickly vegetated grasslands.

Figure 6 shows the small mammal trapping locations, and Table 19 gives the trapping results. The deer mouse (Peromyscus maniculatus) was by far the most common (90 percent of 102 total catches) of the four species captured during the fall survey. It was abundant in both juniper woodland (Station 5) and mixed woodland (Station 2). The deer mouse was the only species captured in the riparian woodland (Station 6), disturbed woodland (Station 4), grazed grassland (Station 1), and the food plot (Station 7), although its numbers were much lower in these habitats than in the woodland habitats. The deer mouse, captured at only rare intervals during the spring survey, made up less than 2 percent of the total catch. Second in abundance during the fall survey was the hispid cotton rat (Sigmodon hispidus) which made up about 6 percent of the catch. This species was most common in the ungrazed grassland (Station 3); however, one individual was taken in mixed woodland. The eastern wood rat

(Neotoma floridana) composed about 3 percent of the catch and was collected in mixed and juniper woodland. Neither the cotton rat nor the wood rat were taken during the spring survey. The two golden harvest mice (Reithrodontomys fulvescens) captured were taken in the ungrazed grassland during the fall survey and in the riparian woodland during the spring.

The Texas Mouse (Peromyscus attwateri), the most common small mammal taken during the spring survey, prefers the mixed deciduous-juniper woodland and disturbed woodland. It was also found in relatively low numbers in the juniper woodlands and ungrazed grassland. The most abundant small mammal observed during the spring survey was the White-ankled Mouse (Peromyscus pectoralis). It was taken in similar numbers in the same habitat as the Texas Mouse, except that it was also found in the grazed grassland. The Merriam Pocket Mouse (Perognathus flavus) was taken in small, but significant numbers in the disturbed woodlands. This mouse is normally a desert dweller and has apparently become resident in the disturbed woodlands, where training has created an "artificial" desert. Other small mammals taken during the spring survey were the Plains Harvest Mouse (Reithrodontomys montanus), the Northern Pygmy Mouse (Baiomys taylori), and an immature Eastern Cottontail (Sylvilagus floridanus), but their numbers were so small (one each) that they could not be used as indicators. One curious development during the analysis of the small mammal trapping data was the discrepancy between the numbers of Deer Mice observed (90 percent of the fall small mammal population, and less than 2 percent of the spring population), and the presence of the Texas Mouse and White-ankled Mouse in the spring census, but not in the fall. This is very unusual and is difficult to explain biologically.

The habitats showing the highest fall small mammal populations, as indicated by trapping, were the juniper woodland (20.4 percent success) and mixed woodland (18.1 percent success). Trapping in the disturbed woodland was considerably less productive (4.7 percent). Ungrazed grassland showed 5.8 percent trapping success as opposed to only 0.4 percent in the grazed grassland. The low trapping success (1.0 percent) in the riparian woodland was somewhat unexpected; however, it may have been due in part to periodic flooding of the low areas sampled.

All areas showed a low trapping success rate in the spring census. This is a fairly common occurrence resulting from the climatic conditions. The trapping success rate in undisturbed juniper woodland was almost twice as high as in any other habitat, but this is not statistically significant.

Table 20 gives the results of the 64-km nocturnal road-cruise census. The white-tailed deer, raccoon, and black-tailed jack rabbit were the most common species seen during the fall cruise. Only one eastern cottontail was observed during the night census. The spring nocturnal road-cruise census showed similar results, except that the high recordings of the Black-Tailed Jack Rabbit were replaced by similarly high recordings of the Eastern Cottontail. It is significant that no coyotes (Canis latrans) were observed either during the quantitative road census or during any other nighttime road hunts. Considering the lack of observations of this species, it seems unlikely that Fort Hood harbors an unusually high coyote population. Support for this statement is provided by the fact that during a 1-year period from 1 March

1977 to 1 March 1978, two trappers caught only 19 coyotes in 2080 manhours of predator control on the reservation.[27]

A 64-km diurnal road-cruise census conducted by the Fort Hood Fish and Wildlife Section in the fall of 1977 counted 0.76 white-tailed deer per km, 0.28 black-tailed jack rabbits per km, and 0.25 eastern cottontails per km.

Important Species

Chapter 2 provides a detailed definition of important species.

Recreationally or Commercially Important Species

Several species of mammals and birds are hunted on the Fort Hood Military Reservation, and therefore represent an important recreational and economic resource. According to Fort Hood records, the estimated hunter days for deer, quail, turkey, and waterfowl in 1974 were 21,470.

The white-tailed deer is the most important big game mammal in Texas.[28] It requires forested stands containing good shrub layers which provide food and cover. Edge situations are often favored for browsing. Twigs of shrubs and trees, acorns, and various herbs and grasses make up the majority of the deer's diet; however, food habits may vary somewhat regionally and seasonally. White-tailed deer populations at Fort Hood are relatively high and have been estimated as follows: 1975 -- one deer per 3.87 ha; 1976 -- one deer per 5.77 ha; 1977 -- one deer per 8.32 ha.[29] A 64-km daytime game census conducted by Fort Hood's Fish and Wildlife Section showed an average of 0.76 deer observed per km in 1977. The nocturnal road-cruise census conducted in the present studies resulted in observations of about 0.11 deer per km in the fall and 0.36 deer per km in the spring. Deer harvest during the 1977-1978 season at Fort Hood was 881.[30] This is down from 1495 in 1976 and 2602 in 1975; however, a downward trend in annual deer harvest is evident statewide.[31]

The fox squirrel is an important small game mammal over much of the state, particularly to the east. Oak mast provides the bulk of the diet for this species, which inhabits woodlands, groves, and savanna. At the Fort Hood Military Reservation, the fox squirrel predominantly inhabits riparian-type forests. By 1974, 360 artificial squirrel nests had been placed in hardwood trees at Fort Hood to increase the breeding potential of this species.

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27 Fort Hood Fish and Wildlife Section, Fort Hood, Texas, personal communication (1978).

28 W. B. Davis, The Mammals of Texas, Bulletin 41 (Texas Parks and Wildlife Department, Austin, 1974).

29 Fort Hood Fish and Wildlife Section, Fort Hood, Texas, personal communication (1978).

30 C. L. Knight, Deer and Turkey Kill by Area 1977-1978 (Fish and Wildlife Section, Fort Hood, Texas, 1978).

31 Texas Parks and Wildlife Department, Job No. 4: Big Game Harvest Regulations (White-Tailed Deer Harvest Surveys), Federal Aid Project No. W-109-R-1 (Texas Parks and Wildlife Department, 1978a).

Although quantitative estimates of squirrel populations are lacking, field observations during the current surveys suggest that squirrel densities are low to moderate over most of the reservation.

The eastern cottontail and the black-tailed jack rabbit, although not strictly defined as game animals, are hunted throughout their ranges in Texas. Eastern cottontails occur in a variety of habitats, including open areas and woodlands; however, they tend to be most abundant along edges. Early morning road-cruise game censuses on Fort Hood have observed 0.25 cottontails per km in 1977, 0.66 per km in 1976, and 0.76 per km in 1975.[32] The nighttime road-cruise census during the current studies indicated only 0.02 per km in the fall and 0.16 per km in the spring. The numbers of black-tailed jack rabbits observed by Fort Hood Fish and Wildlife Section biologists during game censuses were 0.42 per km in 1975, 0.40 per km in 1976, and 0.28 per km in 1977.[33] During the night census of this study, 0.11 jack rabbits per km were observed in the fall and 0.02 per km in the spring.

Furbearers (e.g., raccoon, opossum, gray fox, coyote, striped skunk, bobcat, and others) are of some economic and recreational importance in Texas. On a statewide basis, furbearers harvested during the 1976-1977 season had an estimated value in excess of $16.2 million.[34] The raccoon was the most commonly observed furbearer during this study. Other furbearers observed included the gray fox, striped skunk, and opossum. Fort Hood Fish and Wildlife Section trappers captured 19 coyotes and 1 bobcat between 1 March 1977 and 1 March 1978; these numbers are low, considering the time period and number of man-hours (2080) expended in the trapping efforts.

The Bobwhite is an important game bird over much of Texas. It prefers open areas and edges which provide grasses and herbs for food, and dense, low woody, and herbaceous vegetation for cover. Bobwhite appear to be fairly common in such habitats at Fort Hood. The Fort Hood Fish and Wildlife Section road census data showed fall populations of 0.25 Bobwhite per km in 1977; data from the present studies showed 0.20 per km on the west side, and 0.05 per km on the east side. Results of the spring cruise showed Bobwhite 0.24 per km on the west side, 0.12 per km on the east side. The fall density, based on the Emlen transect in grazed grassland, was 39.6 Bobwhite per 100 ha. Spring transects showed Bobwhite in all areas except disturbed woodlands and the deciduous-juniper woodland.

The Mourning Dove is the most widespread and abundant gamebird in Texas. Doves seem to prefer semi-open country and edges, but are also common in heavily wooded areas and extensively cultivated prairies. They typically nest in wooded vegetation and feed in more open areas. The Mourning Dove was among the most common species observed during the present surveys. Census data from the 29 August 1978 road cruise in mixed-woodland showed 0.75 doves per km on the east side and 0.22 per km on the west side. A 1977 census by the Fort Hood Fish and Wildlife

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32 Fort Hood Fish and Wildlife Section, Fort Hood, Texas, personal communication (1978).

33 Fort Hood Fish and Wildlife Section.

34 Texas Parks and Wildlife Department, Job No. 13: Evaluation of the Annual Fur Harvest, Federal Aid Project No. W-103-R-7 (Texas Parks and Wildlife Department, 1978b).

Section showed 0.65 doves per km. These figures approach the statewide average of 0.85 per km between 1966 and 1977.

The Turkey is an important game bird in certain areas of Texas where it has been reintroduced. Turkeys prefer to nest in woody vegetation which is at least 45 cm high. They feed on acorns, fruits, and seeds. The Turkey population, estimated to be 1430 at Fort Hood during 1977, is most commonly found in riparian woodland. During the present study, 11 Turkeys were seen during the road-cruise census on the west side of Fort Hood.

Several species of waterfowl are likely to use suitable aquatic habitats on Fort Hood during the proper seasons. While most individuals migrate to areas further south, some (e.g., Blue-winged Teal, Mallard, and Green-winged Teal) often take up winter residence in the area. Table 10 lists species which might be expected in the area.

Threatened and Endangered Species

Several species considered to be endangered, threatened, or peripheral by the Texas Organization for Endangered Species, the Texas Parks and Wildlife Department, and/or the U.S. Department of the Interior may be found in the Fort Hood region. Table 21 lists these species and their status.

Of the 12 species listed, only two are considered endangered by the U.S. Department of the Interior: the Bald Eagle (Haliaeetus leucocephalus) and the Peregrine Falcon. The Peregrine Falcon, which was observed during the present studies, breeds in the North American tundra and generally winters in Central and South America; it is a rare migrant through the Fort Hood area. The single Peregrine observed during the fall survey probably used the reservation as a temporary resting place and may have preyed to some extent on small birds and rodents of the area. Beaty[35] reported a sighting of this species in 1976 in the Fort Hood area. Decline of this species has been attributed to the buildup of chlorinated hydrocarbon pesticides in the environment.[36]

The Bald Eagle is generally found in coastal areas or around large inland bodies of water. Belton Lake provides suitable habitat in the Fort Hood area. Between 1971 and 1976, nine Bald Eagle sightings were reported from Bell County (all in 1972 and 1973), and none were reported from Coryell County.[37] Although the species once bred over most of the state, its Texas breeding range is now restricted mainly to coastal areas.[38] It should be considered a rare, but possible, winter resident in the Fort Hood area.

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35 H. E. Beaty, personal communication, Temple, Texas (1978b).

36 J. J. Hickey and D. W. Anderson, "Chlorinated Hydrocarbons and Eggshell Changes in Raptorial and Fish-Eating Birds," Sci., No. 162 (1968), pp 271-273.

37 Texas Parks and Wildlife Department, Job No. 30: Bald Eagle-Osprey Survey, Federal Aid Project No. W-103-R-6 (Texas Parks and Wildlife Department, 1976).

38 H. C. Oberholser The Bird Life of Texas, Vol. 1 and 2 (University of Texas Press, 1974).

In addition to the Peregrine Falcon and Bald Eagle, the Texas Parks and Wildlife Department[39] considers a subspecies of the Least Tern (Sterna albifrons athalossos) to be endangered. This bird may migrate through the Fort Hood area; however, breeding is highly unlikely, since the southern limits of its believed breeding range lie just north of Fort Hood.[40] In addition, suitable nesting habitats (sandy flats or bars along rivers) are not present at Fort Hood.

A species of special concern is the Golden-cheeked Warbler, which TOES considers to be endangered. This species has a breeding range restricted to suitable mature (more than 50 years old) Ashe juniper habitats in central Texas.[41] Urbanization and clearing of old juniper stands for posts are suspected reasons for the endangered status of this species. Fort Hood has significant areas of good Golden-cheeked Warbler habitat; however, the actual distribution of the species at Fort Hood could not be determined in this study, since it is a spring and early summer resident. Much of its habitat has been protected from disturbance by a U.S. Army agreement to limit activities in designated areas during the breeding season, as well as to prevent commercial cutting of juniper in the Golden-cheeked Warbler's habitat at all times. Figure 6 indicates these protected areas; care should be taken to prevent unauthorized activities in these habitats. Pulich states that Fort Hood can probably support one pair of Golden-cheeked Warblers per 20 ha.

The Osprey (Pandion haliaetus) is another endangered species (according to TOES) which may be found in the Fort Hood area. This fish-eating hawk is found along sea coasts, rivers, and lakes. Recent breeding records for Texas are extremely sparse; however, wintering and migrating individuals may occasionally use Belton Lake for feeding. Between 1971 and 1976, 39 Osprey sightings were reported in Bell County, while none were reported in Coryell County.[42] One was seen on several occasions during the spring survey near Belton Lake.

The Roseate Spoonbill (peripheral, according to TOES) is a predominantly coastal species. Some individuals (particularly first- and second-year birds) may wander northward after the breeding season.[43] An immature of this species was observed feeding and roosting in a shallow pond just north of the Main

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39 Texas Parks and Wildlife Department, Regulations for Taking, Possessing, Transporting, Exporting, Processing, Selling or Offering for Sale, or Shipping Endangered Species, 127.30.09.001-006 as amended July 1977 (Texas Parks and Wildlife Department, 1977).

40 H. C. Oberholser, The Bird Life of Texas, Vol. 1 and 2 (University of Texas Press, 1974).

41 W. M. Pulich, The Golden-Cheeked Warbler (Texas Parks and Wildlife Department, Austin, 1976).

42 Texas Parks and Wildlife Department, Job No. 30: Bald Eagle-Osprey Survey, Federal Aid Project No. W-103-R-6 (Texas Parks and Wildlife Department, 1976).

43 H. C. Oberholser, The Bird Life of Texas, Vol. 1 and 2 (University of Texas Press, 1974).

Cantonment Area on several days during the field surveys. Beaty[44] reported other recent sightings of the species in the same general area. This species probably occurs only irregularly at Fort Hood and should not be considered a seasonal resident. Other irregularly or doubtfully occurring species in the Fort Hood area are the White-faced Ibis (Plegadis chihi) (threatened according to TOES) and the Fulvous Whistling Duck (Dendrocygna bicolor) (endangered according to TOES).

TOES considers the Prairie Falcon (Falco mexicanus) and the Merlin (Falco columbarius) to be threatened. The Prairie Falcon is a bird of the prairies, plains, and deserts, in contrast to the coast-, woods-, and mountain-seeking Peregrine Falcon.[45] Oberholser states that the Prairie Falcon is "uncommon to scarce in the western third (of Texas); increasingly rare and irregular eastward to 96th meridian and upper coast." It is highly unlikely that it will use the Fort Hood area to a large extent, although its occurrence there would not be totally unexpected. The Merlin is found in woodland openings and edges of lakes, rivers, ponds, and marshes.[46] It may occur as a rare migrant or winter resident at Fort Hood.

The only mammal considered to be endangered or threatened which might be observed at Fort Hood is the mountain lion (Felis concolor) (endangered, according to TOES). This species occurs sparsely over much of the state in brushy or wooded deer habitat.[47] It is possible that this species be found in the Fort Hood area; however, due to the large amount of activity in the area, it would seem unlikely that a mountain lion could remain undetected if it were present.

No threatened or endangered amphibians or reptiles are expected to be found at Fort Hood.

Other Important Species

No species found at Fort Hood fall under criteria (3) and (4) defined in Chapter 2 (p 24). All of the above-mentioned "important species" have varied food habits and do not depend solely on another single species.

Energy flows from primary producers (plants) through primary, secondary, and tertiary consumers. Scavengers derive energy from any level, a large part of their diets being carrion. Many of the species listed for a given trophic level may actually function at several levels depending on the season and food availability. Rodents consume insects as well as vegetation. Seed-eating songbirds harvest insects to feed nestlings. Raccoons, skunks, opossums, and many other species are omnivorous. Singularly, none of these species is critical to the structure or function of the ecosystem. A change in the abundance of one species will result in compensatory changes in other species'

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44 H. E. Beaty, personal communication, Temple, Texas (1978b).

45 H. C. Oberholser The Bird Life of Texas, Vol. 1 and 2 (University of Texas Press, 1974).

46 H. C. Oberholser, The Bird Life of Texas, Vol. 1 and 2 (University of Texas Press, 1974).

47 W. B. Davis, The Mammals of Texas, Bulletin 41 (Texas Parks and Wildlife Department, Austin, 1974).

populations so that the overall pattern of energy flow is not adversely affected.

Significance of Local Wildlife

The terrestrial vertebrate fauna of the Fort Hood Military Reservation are generally typical of central Texas. The presence of habitat for the endangered (according to TOES) Golden-cheeked Warbler is significant due to the limited range of the species and the relatively fast pace at which suitable juniper habitats are being encroached upon. Protection of Golden-cheeked Warbler habitat should be of prime importance. No other resident faunal species of special scientific importance or limited distribution was found on the reservation.

Hunting and trapping at Fort Hood provide many man-days of recreation and, as such, provide an important economic resource for the area.

Table 9

Reptiles and Amphibians--Fort Hood

Common Name*	Scientific Name	General Habitat Preference	Observed in Project Area
Common snapping turtle	Chelydra serpentina	S	
Stinkpot	Stenotherus odoratus	S	
Yellow mud turtle	Kinosternon flavescens	S	
Texas river cooter	Chrysemys concinna	S	
Red-eared turtle	Chrysemys scripta	S	XO
Three-toed box turtle	Terrapene carolina	G,F	
Ornate box turtle	Terrapene ornata	G	
Spiny softshell	Trionyx spiniferus	S	
Smooth softshell	Trionyx muticus	S	
Green anole	Anolis carolinensis	B,F	
Collared lizard	Crotophytus collaris	rocky areas	XO
Texas horned lizard	Phrynosoma cornutum	G	O
Eastern earless lizard	Holbrookia maculata	G	
Texas greater earless lizard	Cophosaurus texanus	open, rocky or gravelly areas	X
Eastern tree lizard	Urosaurus ornatus	trees or rocks	
Texas spiny lizard	Sceloporus olivaceus	B,F	XO
Southern prairie lizard	Sceloporus undulatus	B,F	
Ground skink	Scincella lateralis	F	O
Great plains skink	Eumeces obsoletus	G	
Four-lined skink	Eumeces tetragrammus	G,B,F	XO
Five-lined skink	Eumeces fasciatus	G,B,F	O
Southern prairie skink	Eumeces septentrionalis	G,B,F	
Texas spotted whiptail	Cnemidophorus gularis	G,B	X
Prairie-lined racerunner	Cnemidophorus sexlineatus	G,B	
Western slender glass lizard	Ophisaurus attenuatus	G	
Diamondback water snake	Nerodia rhombifera	S	XO

[1]Distributions follow Conant (1975) and Raun and Gehlback (1972); nomenclature follows Collins et al. (1978).

[2]Habitat preference

[3]General reconnaissance survey conducted 6-7 March 1979.

S - aquatic associated habitats
G - grasslands and other open areas
B - brushlands
F - forest and woodlands

X = observed Fall 1978
O = observed Spring 1979

*For an explanation of terminology in table headings, see the appendix.

Table 9 (Cont'd)

Common Name	Scientific Name	General Habitat Preference	Observed in Project
Blotched water snake	Nerodia erythrogaster	S	X
Texas garter snake	Thamophis sirtalis	S,G,F	
Checkered garter snake	Thamnophis marcianus	S	
Eastern blackneck garter snake	Thamnophis cyrtopsis	rocky hillsides, limestone hillsides, & cedar brakes	X (new county record)
Redstripe ribbon snake	Thamnophis proximus	S	X
Plains blind snake	Leptotyphlops dulcis	subterranean, stony hillsides & prairies	
Texas lined snake	Tropidoclonian lineatum	G,F	
Rough earth snake	Virginia striatula	G,F	
Smooth earth snake	Virginia valeriae	G	
Texas brown snake	Storsria dekayi	S,F,G,B,	
Eastern hognose snake	Heterodon platyrhinos	G	
Western hognose snake	Heterodon nasicus	G	
Ringneck snake	Diadophis punctatus	S,F	
Rough green snake	Opheodrys aestivus	S,F,B	O
Eastern yellowbelly racer	Coluber constrictor	G,B,F	
Western coachwhip	Masticophis flagellum	G,B	O
Texas patchnose snake	Salvadora grahamiae	G,B	X
Bullsnake	Pituophis melanoleucus	G	
Texas rat snake	Elaphe obsoleta	S,B,B,F	
Great plains rat snake	Elaphe guttata	rocky areas, hillsides	
Mexican milk snake	Lampropeltis triangulum	G	
Desert and/or speckled kingsnake	Lampropeltis getulus	S,G S,G	
Great Plains ground snake	Sonora episcopa	rocky hillsides	X
Longnose snake	Rhinocheilus lecontei	G	
Flatheaded snake	Tantilla gracilis	under rocks, debris, etc.	
Texas night snake	Hypsiglena torquata	G	
Western cottonmouth	Agkistrodon piscivorus	S	
Broad-banded copperhead	Agkistrodon contortrix	S,F	

Table 9 (Cont'd)

Common Name	Scientific Name	General Habitat Preference	Observed in Project Area
Texas coral snake	Micrurus fulvius	cedar brakes, rocky areas	
Western massasauga	Sistrurus catenatus	G, rocky areas	
Timber rattlesnake	Crotalus horridus	B,F	
Western diamondback rattlesnake	Crotalus atrox	G,B,F rocky areas	O
Smallmouth salamander	Ambystoma texanum	S,F	
Barred tiger salamander	Ambystoma tigrinum	S,G	
Slimy salamander	Plethodon glutinosus	S,F	
Couch's spadefoot	Scaphiopus couchi	G,B	
Great plains narrow-mouth toad	Gastrophryne olivacea	G,B,F,S	
Woodhouse's toad	Bufo woodhousei	G,B,F,S	
Eastern green toad	Bufo debilis	G,B,S	
Texas toad	*Bufo speciosus*	G,B,S	
Red-spotted toad	Bufo punctatus	G,S, rocky areas	
Gulf coast toad	Bufo valliceps	G,B,F,S	
Gray treefrogs	Hyla versicolor and/or H. chrysoscelis	B,F,S	
Green treefrog	Hyla cinerea	F,S	
Strecker's chorus frog	Pseudacris streckeri	S,G,B,F	O
Spotted chorus frog	Psuedacris clarki	G,S	
Blanchard's cricket frog	Acris crepitans	S	X
Bullfrog	Rana catesbeiana	S	
Plains leopard frog	Rana blairi	G,S	
Rio Grande leopard frog	Rana berlandieri	G,B,F,S	

Table 10

Birds--Fort Hood

Common Name*	Scientific Name	Habitat Preference	Season	Abundance of Species Observed During Survey	
				Fall	Spring
Common Loon	Gavia immer	S	M,WR		
Horned Grebe	Podiceps auritus	S	M,WR		
Eared Grebe	Podiceps nigricollis	S	M,WR		U
Western Grebe	Aechmophorus occidentalis	S	M,WR		
Pied-billed Grebe	Podilymbus podiceps	S	M,R	U	
White Pelican	Pelicanus erythrorhynchos	S	M		
Double-crested Cormorant	Phalacrocorax auritus	S	M,WR		C
Anhinga	Anhinga anhinga	S	V		
Great Blue Heron	Ardea herodias	S	R	C	U
Great Egret	Casmerodius albus	S	SR	C	U
Snowy Egret	Egretta thula	S	SR		
Louisiana Heron	Hydranassa tricolor	S	M	C	
Green Heron	Butorides virescens	S	SR	C	U
Little Blue Heron	Florida caerulea	S	SR	U	
Cattle Egret	Bubulcus ibis	SG	R		
Black-crowned Night Heron	Nycticorax nycticorax	S	SR		
Yellow-crowned Night Heron	Nyctanassa violacea	S	SR	U	
American Bittern	Botaurus lentiginosus	S	M		
Least Bittern	Ixobrychus exilis	S	SR		
Wood Stork	Mycteria americana	S	M		
Roseate Spoonbill	Ajaia ajaja	S	C	U	
White-faced Ibis	Plegadis chihi	S	M		
Whistling Swan	Olor columbianus	S	WV		
Canada Goose	Branta canadensis	SG	M		
White-fronted Goose	Anser albifrons	SG	M		
Snow Goose	Chen caerulescens	SG	M		
Fulvous Whistling Duck	Dendrocygna bicolor	SG	C		

*For an explanation of terminology in table headings, see the appendix

Table 10 (Cont'd)

Common Name	Scientific Name	Habitat Preference	Season	Abundance of Species Observed During Survey	
				Fall	Spring
Mallard	Anas platyrhynchos	S	M,WR		
Black Duck	Anas rubripes	S	M,WR		
Mottled Duck	Anas fulvigula	S	V		
Gadwall	Anas strepera	S	M,WR		
Pintail	Anas acuta	S	M,WR		
Green-winged Teal	Anas crecca	S	M,WR	U	
Blue-winged Teal	Anas discors	S	M,R	C	U
Cinnamon Teal	Anas cyanoptera	S	M		
American Wigeon	Anas americana	S	M,WR		
Northern Shoveler	Anas clypeata	S	M,WR		U
Wood Duck	Aix sponsa	S	M,R		
Redhead	Aythya americana	S	M,WR		
Ring-necked Duck	Aythya collaris	S	M,WR		
Canvasback	Aythya valisineria	S	M,WR		
Greater Scaup	Aythya marila	S	M		U
Leaser Scaup	Aythya affinis	S	M,WR	U	
Common Goldeneye	Bucephala clangula	S	M,WR		
Bufflehead	Bucephala albeola	S	M,WR		
Oldsquaw	Clangula hyemalis	S	M		
White-winged Scoter	Melanitta deglandi	S	M		
Ruddy Duck	Oxyura jamaiscensis	S	M,WR		
Hooded Merganser	Lophodyts cucullatus	S	M,WR		
Common Merganser	Mergus merganser	S	M,WR		
Red-breasted Merganser	Mergus serrator	S	M,WR		
Turkey Vulture	Cathartes aura	GRUE	R	A	C
Black Vulture	Coragyps atratus	GRUE	R	C	U
Mississippi Kite	Ictinia mississippiensis	GUE	M		U
Sharp-shinned Hawk	Accipiter striatus	RUS	M,WR		
Cooper's Hawk	Accipiter cooperii	GRUE	R		

Table 10 (Cont'd)

Common Name	Scientific Name	Habitat Preference	Season	Abundance of Species Observed During Survey	
				Fall	Spring
Red-tailed Hawk	Buteo jamaicensis	GRUE	R	U	
Red-shouldered Hawk	Buteo lineatus	RUE	R		
Ferruginous Hawk	Buteo regalis	GRUE	C		
Broad-winged Hawk	Buteo platypterus	UE	M		
Swainson's Hawk	Buteo swainsoni	GE	M,SR	U	
Rough-legged Hawk	Buteo lagopus	SG	M		U
Harris' Hawk	Parabuteo unicinctus	GU	R		
Golden Eagle	Aquila chrysaetos	GU	M,WR		
Bald Eagle	Haliaeetus leucocephalus	SR	M,WR		
Marsh Hawk	Circus cyaneus	SG	M,WR		U
Osprey	Pandion haliaetus	S	M		U
Caracara	Caracara cheriway	GUE	M		
Prairie Falcon	Falco mexicanus	G	M		
Peregrine Falcon	Falco peregrinus	G	M	U	
American Kestrel	Falco sparverius	G	M,WR	C	C
Merlin	Falco columbarius	SG	M,WR		
Bobwhite	Colinus virginianus	GUE	R	C	C
Turkey	Meleagris gallopavo	RUE	R	U	C
Sandhill Crane	Grus canadensis	G	M		
King Rail	Rallus elegans	S	SR		
Sora	Porzana carolina	S	M		
Purple Gallinule	Porphyrula martinica	S	M		
Common Gallinule	Gallinula chloropus	S	SR		
American Coot	Fulica americana	S	R		U
Semipalmated Plover	Charadrius semipalmatus	S	M		
Piping Plover	Charadrius melodus	S	M		
Snowy Plover	Charadrius alexandrinus	S	M		
Killdeer	Charadrius vociferus	SG	R	C	C
Mountain Plover	Charadrius montana	G	M		

Table 10 (Cont'd)

Common Name	Scientific Name	Habitat Preference	Season	Abundance of Species Observed During Survey	
				Fall	Spring
American Golden Plover	Pluvialis dominica	SG	M		
Black-bellied Plover	Pluvialis squatarola	SG	M		
American Woodcock	Philohela minor	RU	M		
Common Snipe	Capella gallinago	S	M,WR		U
Long-billed Curlew	Numenius americanus	SG	M		
Whimbrel	Numenius phaeopus	SG	M		
Upland Sandpiper	Bartramia longicauda	G	M		
Spotted Sandpiper	Actitic maculeria	S	M	U	
Solitary Sandpiper	Tringa solitaria	SR	M	U	
Greater Yellowlegs	Tringa melanoleucus	S	M,WR		
Lesser Yellowlegs	Tringa flavipes	D	M,WR	U	
Willet	Catoptrophorus semipalmatus	S	M		
Red Knot	Calidris canutus	S	M		
Pectoral Sandpiper	Calidris melanotos	SG	M		
White-rumped Sandpiper	Calidris fuscicollis	SG	M		
Baird's Sandpiper	Calidris bairdii	S	M		
Least Sandpiper	Calidris minutilla	S	M,WR	U	
Dunlin	Calidris alpina	S	M		
Semipalmated Sandpiper	Calidris pusillus	S	M	U	
Western Sandpiper	Calidris mauri	S	M,WR	U	
Sanderling	Calidris alba	S	M		U
Short-billed Dowitcher	Limnodromus griseus	S	M		
Long-billed Dowitcher	Limnodromus scolopaceus	S	M		
Stilt Sandpiper	Micropalama himantopus	S	M		
Buff-breasted Sandpiper	Tryngites subruficollis	S	M		
Marbled Godwit	Limosa fedoa	SG	M		
Hudsonian Godwit	Limosa haemastica	S	M		
American Avocet	Recurvirostra americana	S	M	U	
Black-necked Stilt	Himantopus mexicanus	S	M,SR		

Table 10 (Cont'd)

Common Name	Scientific Name	Habitat Preference	Season	Abundance of Species Observed During Survey	
				Fall	Spring
Northern Phalarope	Lobipes lobatus	S	M		
Wilson's Phalarope	Steganopus tricolor	S	M		
Herring Gull	Larus argentatus	S	M,WR		
Ring-billed Gull	Larus delawarensis	S	M.WR		
Franklin's Gull	Larus pipixcan	SG	M		
Bonaparte's Gull	Larus philadelphia	S	M,WR		
Forster's Tern	Sterna forsteri	S	M		U
Least Tern	Sterna albifrons	S	M		
Black Tern	Chlidonias niger	S	M		
Mourning Dove	Zenaida macroura	GRUE	R	A	A
Ground Dove	Columbina passerina	GUE	C		
Inca Dove	Scardafella inca	G,H	R		
Rock Dove	Columba livia	H	R	C	C
Yellow-billed Cuckoo	Coccyzus americanus	RUE	M,SR	C	U
Black-billed Cuckoo	Coccyzus erthropthalmus	UE	M		
Roadrunner	Geococcyx californianus	GU	R	C	
Groove-billed Ani	Crotophaga sulcirostris	U	C		
Barn Owl	Tyto alba	UEH	R		
Screech Owl	Otus asio	SU	R	U	
Great Horned Owl	Bubo virginianus	SU	R		U
Burrowing Owl	Athene cunicularis	G	R		
Barred Owl	Strix varia	RU	R	U	
Long-eared Owl	Asio otus	U	M,WR		
Short-eared Owl	Asio flammeus	SG	M,WR		
Chuck-will's-widow	Caprimulgus carolinensis	RUE	M,SR		C
Whip-poor-will	Caprimulgus vociferus	UE	M		
Poor-will	Phalaenoptilus nuttallii	RUE	M,SR	U	
Common Nighthawk	Chordeiles minor	GRUEH	M,SR	C	
Lesser Nighthawk	Chordeiles acutipennis	GRUEH	SR		

Table 10 (Cont'd)

Common Name	Scientific Name	Habitat Preference	Season	Abundance of Species Observed During Survey	
				Fall	Spring
Chimney Swift	Chaetura pelagica	UH	M,SR	U	U
White-throated Swift	Aeronautes saxatalis	UEH	C		
Ruby-throated Hummingbird	Archilochus colubris	GUH	M,SR		U
Black-chinned Hummingbird	Archilochus alexandri	GUH	M,SR		
--	Archilochus sp. (includes two above species)	GUH	M	U	
Rufous Hummingbird	Selasphorus rufus	GUH	M		
Belted Kingfisher	Megaceryle alcyon	S	R	C	
Common Flicker	Colaptes auratus	GUH	R		
Red-bellied Woodpecker	Melanerpes carolinus	UH	R	C	U
Golden-fronted Woodpecker	Melanerpes aurifrons	UH	R		
Red-headed Woodpecker	Melanerpes erythrocephalus	UH	R		
Hairy Woodpecker	Picoides villosus	U	M,WR		U
Downy Woodpecker	Picoides pubescens	U	R	C	U
Ladder-backed Woodpecker	Picoides scalaris	U	R	C	U
Yellow-bellied Sapsucker	Sphyrapicus varius	U	M,WR		
Eastern Kingbird	Tyrannus tyrannus	GUE	M,SR		U
Western Kingbird	Tyrannus verticalis	GUE	M,SR		
Scissor-tailed Flycatcher	Muscivora forficata	GUE	M,SR	C	C
Great Crested Flycatcher	Myiarchus crinitus	RU	M,SR	U	U
Ash-throated Flycatcher	Myiarcbus cinerascens	U	M,SR		
Eastern Phoebe	Sayornis phoebe	SGHE	R		
Black Phoebe	Sayornis nigricans	SE	V		
Say's Phoebe	Sayornis sayus	GR	M,WR		U
Yellow-bellied Flycatcher	Empidonax flaviventris	RUE	M	U	
Acadian Flycatcher	Empidonax virescens	SUE	M,SR		
Willow Flycatcher	Empidonax traillii	SG	M,SR		
Least Flycatcher	Empidonax minimus	UE	M		
--	Empidonax sp. (includes above four species)	--	--	U	U
Eastern Wood Pewee	Contopus virens	UE	M,SR	U	U

Table 10 (Cont'd)

Common Name	Scientific Name	Habitat Preference	Season	Abundance of Species Observed During Survey	
				Fall	Spring
Olive-sided Flycatcher	Nuttallornis borealis	UE	M		
Vermilion Flycatcher	Pyrocephalus rubinus	SU	M,SR		
Horned Lark	Eremophila alpestis	G	R		C
Tree Swallow	Iridoprocne bicolor	SGR	M		
Bank Swallow	Riparia riparia	SGR	M,SR		
Rough-winged Swallow	Stelgidopteryx ruficollis	SGR	SR		U
Barn Swallow	Hirundo rustica	SGR	M,SR	U	U
Cliff Swallow	Petrochelidon pyrrhonota	SGR	M,SR		
Purple Martin	Progne subis	UH	M,SR		U
Blue Jay	Cyanacitta cristata	UH	R	U	
Scrub Jay	Aphelocoma coerulescens	U	R		
Common Crow	Corvus brachyrhynchos	GRUE	R	C	C
Carolina Chickadee	Parus carolinensis	UEH	R	A	U
Tufted Titmouse	Parus bicolor	RUE	R	A	A
Verdin	Auriparus flaviceps	U	R		
Bushtit	Psaltriparus minimus	RUE	R		
White-breasted Nuthatch	Sitta carolinensis	UF	R		U
Red-breasted Nuthatch	Sitta canadensis	UE	M,WR		
Brown Creeper	Certhia familaris	EU	M,WR		
House Wren	Troglodytes aedon	UEH	M,WR		U
Winter Wren	Troglodytes troglodytes	U	M,WR		
Bewick's Wren	Thryomanes bewickii	UEH	R	C	U
Carolina Wren	Thryothorus ludovicianus	UEH	R	C	U
Cactus Wren	Campylorhynchus brunneicapillus	U	R		
Long-billed Marsh Wren	Cistothorus palustris	S	M,WR		
Short-billed Marsh Wren	Cistothorus platensis	SG	M,WR		
Canyon Wren	Catherpes mexicanus	RUE	R	U	
Rock Wren	Salpinctes obsoletus	U	R		
Mockingbird	Mimus polyglottos	GUEH	R	C	A
Gray Catbird	Dumetella carolinensis	RU	M,WR		

Table 10 (Cont'd)

Common Name	Scientific Name	Habitat Preference	Season	Abundance of Species Observed During Survey	
				Fall	Spring
Brown Thrasher	Toxostoma rufum	RU	R	U	
Curve-billed Thrasher	Toxostoma curvirostre	U	R		
Sage Thrasher	Oreoscoptes montanus	U	M,WR		
American Robin	Turdus migratorius	GUEH	R		U
Wood Thrush	Hylocichla mustelina	RU	M		
Hermit Thrush	Catharus guttatus	RU	M,WR		
Swainson's Thrush	Catharus ustulatus	R	M		U
Gray-checked Thrush	Catharus minimum	RU	M		
Veery	Catharus fuscescens	RU	M		U
Eastern Bluebird	Sialia sialis	GUE	R	U	
Mountain Bluebird	Sialia currucoides	GU	M,WR		
Townsend's Solitaire	Myadestes townsendi	U	M,WR		
Blue-gray Gnatcatcher	Polioptila caerulea	RUE	M,SR	U	U
Golden-crowned Kinglet	Regulus satrapa	RUE	M,WR		
Ruby-crowned Kinglet	Regulus calendale	RUE	M,WR		U
Water Pipit	Anthus spinoletta	SG	M,WR		
Sprague's Pipit	Anthus spragueii	G	M,WR		
Cedar Waxwing	Bombycilla cedrorum	GUEH	M,WR		U
Loggerhead Shrike	Lanius ludovicianus	GE	R	C	C
Starling	Sturnus vulgaria	GH	R	C	C
Black-capped Vireo	Vireo articapilla	U	M,SR	U	U
White-eyed Vireo	Vireo griseus	RUE	M,SR	C	U
Bell's Vireo	Vireo bellii	UE	M,SR	U	
Yellow-throated Vireo	Vireo flavifrons	RU	M,SR		
Solitary Vireo	Vireosylva solitarius	UE	M,WR		
Red-eyed Vireo	Vireo olivaceus	RU	M,SR		C
Philadelphia Vireo	Vireo philadelphicus	RU	M		
Warbling Vireo	Vireo gilvus	RU	M		
Black-and-white Warbler	Miniotilta varia	RU	M,SR	U	U
Prothonotary Warbler	Protonotaria citrea	R	M		

Table 10 (Cont'd)

Common Name	Scientific Name	Habitat Preference	Season	Abundance of Species Observed During Survey	
				Fall	Spring
Worm-eating Warbler	Helmitheros vermivorus	RU	C		
Golden-winged Warbler	Vernivora chrysoptera	UE	M		
Blue-winged Warbler	Vermivora pinus	UE	M		
Tennessee Warbler	Vermivora peregrina	RUE	M		
Orange-crowned Warbler	Vermivora celata	GRUE	M,WR		
Nashville Warbler	Vermivora ruficapilla	RUE	M		U
Northern Parula	Parula americana	RUE	M,SR		
Yellow Warbler	Dendroica petechia	RU	M	U	
Magnolia Warbler	Dendroica magnolia	RUE	M		
Cape May Warbler	Dendroica tigrina	RUE	M		
Black-throated Blue Warbler	Dendroica caerulescens	R	M		
Yellow-rumped Warbler	Dendroica coronata	RUE	M,WR		U
Black-Throated Gray Warbler	Dendroica nigrescens	UE	M		
Black-Throated Green Warbler	Dendroica virens	RUE	M		U
Golden-cheeked Warbler	Dendroica chrysoparia	UE	SR		
Cerulean Warbler	Dendroica cerulea	RUE	M		
Blackburnian Warbler	Dendroica fusca	RUE	M		
Yellow-throated Warbler	Dendroica dominica	RUE	M,SR		
Chestnut-sided Warbler	Dendroica pensylvanica	RUE	M		
Bay-breasted Warbler	Dendroica castanea	RUE	M		
Blackpoll Warbler	Dendroica striata	UE	M		
Prairie Warbler	Dendroica discolor	UE	M		
Pine Warbler	Dendroica pinus	RUE	M		
Palm Warbler	Dendroica palmarum	G	M		
Ovenbird	Seiurus aurocapillus	RU	M		U
Northern Waterthrush	Seiurus noveboracensis	SRU	M		
Louisiana Waterthrush	Seiurus motacilla	SRU	M,SR		
Kentucky Warbler	Oporornis formosus	RU	M,SR		
Mourning Warbler	Oporornis philadelphia	RU	M		

Table 10 (Cont'd)

Common Name	Scientific Name	Habitat Preference	Season	Abundance of Species Observed During Survey	
				Fall	Spring
MacGillivray's Warbler	Oporornis tolmiei	RU	M		
Common Yellowthroat	Geothlypis trichas	RU	M,WR		
Yellow-breasted Chat	Icteria virens	RU	M,SR		
Hooded Warbler	Wilsonia citrina	RU	M		
Wilson's Warbler	Wilsonia pusilla	RU	M	U	
Canada Warbler	Wilsonia canadensis	RU	M		
American Redstart	Setophaga ruticilla	RU	M		
House Sparrow	Passer domesticus	H	R	A	A
Bobolink	Dolichonyx oryzivorus	G	M		
Eastern Meadowlark	Sturnella magna	G	R	U	A
Western Meadowlark	Sturnella neglecta	G	R		
Yellow-headed Blackbird	Xanthocephalus xanthocephalus	SG	M		U
Red-winged Blackbird	Agelaius phoeniceus	SG	R	U	U
Orchard Oriole	Icterus spurius	UEH	M,SR		
Northern Oriole	Ictarus galbula	RUE	M,SR	U	
Rusty Blackbird	Euphagus carolinus	R	M,WR		
Brewer's Blackbird	Euphagus cyanocephalus	GH	M,WR		U
Great-tailed Grackle	Quiscalus mexicanus	UEH	R	U	C
Common Grackle	Quiscalus quiscula	SGH	R	C	
Brown-headed Cowbird	Molothrus ater	GUE	R		C
Western Tanager	Piranga ludoviciana	UE	M		
Scarlet Tanager	Piranga olivacea	RU	M		
Summer Tanager	Piranga rubra	RU	M,SR	C	C
Cardinal	Cardinalis cardinalis	RUEH	R	A	A
Rose-breasted Grosbeak	Pheucticus ludovicianus	RU	M		
Black-headed Grosbeak	Pheucticus melanocephalus	RU	M		
Blue Grosbeak	Guiraca caerulea	UE	M,SR		
Indigo Bunting	Passerina cyanea	UE	M,SR		U
Lazuli Bunting	Passerina amoena	GRU	M		
Painted Bunting	Passerina ciris	GUE	M,SR	U	U

Table 10 (Cont'd)

Common Name	Scientific Name	Habitat Preference	Season	Abundance of Species Observed During Survey	
				Fall	Spring
Dickcissel	Spica americana	G	M,SR		U
Evening Grosbeak	Hesperiphona vespertina	UE	WV		
Purple Finch	Carpodacus purpureus	RUE	WV		
House Finch	Carpodacus mexicanus	UH	R	U	
Pine Siskin	Carduelis pinus	UEH	M,WR		
American Goldfinch	Carduelis tristis	UEH	M,WR		U
Lesser Goldfinch	Carduelis psaltria	GUE	R	U	
Green-tailed Towhee	Pipilo chlorura	UE	M,WR		
Rufous-sided Towhee	Pipilo erythrophthalmus	RUE	M,WR		U
Brown Towhee	Pipilo fuscus	UE	M	U	
Lark Bunting	Calamospiza melanocorys	G	M,WR		
Savannah Sparrow	Passerculus sandwichensis	G	M,WR		U
Grasshopper Sparrow	Ammodramus savannarum	G	R		
Henslow's Sparrow	Ammodramus henslowii	G	M		
Vesper Sparrow	Pooecetes gramineus	GU	M,WR		U
Lark Sparrow	Chondestes grammacus	GUE	R	C	A
Rufous-crowned Sparrow	Aimophila ruficeps	GUE	R	U	U
Cassin's Sparrow	Aimophila cassinii	G	R		U
Black-throated Sparrow	Amphispiza bilineata	G	R		
Dark-eyed Junco	Junco hyemalis	GUE	M,WR		
Chipping Sparrow	Spizella passerina	UE	R		U
Clay-colored Sparrow	Spizella pallida	G	M,WR		
Field Sparrow	Spizella pusilla	GE	R	U	U
Harris' Sparrow	Zonotrichia querula	RUE	M,WR		
White-crowned Sparrow	Zonotrichia leucophrys	UEH	M,WR		U
White-throated Sparrow	Zonotrichia albicollis	RU	M,WR		U
Fox Sparrow	Passerella iliaca	RU	M,WR		
Lincoln's Sparrow	Melospiza lincolnii	GRUE	M,WR		U
Swamp Sparrow	Melospiza georgiana	S	M,WR		
Song Sparrow	Melospiza melodia	R	M,WR		U

Table 10 (Cont'd)

Common Name	Scientific Name	Habitat Preference	Season	Abundance of Species Observed During Survey	
				Fall	Spring
McCown's Longspur	Calcarius mccownii	G	M,WR		
Chestnut-collared Longspur	Calcarius ornatus	G	M,WR		
Lapland Longspur	Calcarius lapporicus	G	M,WR		
Smith's Longspur	Calacrius pictus	G	M,WR		

[1]Source: Wolfe et al. (1974), Oberholser (1974), Peterson (1963); nomenclature follows AOU (1957, 1973, 1976).

[2]Habitat Preference:
- S - aquatic associated habitats
- G - grasslands, pastures, and other open areas
- R - riparian woodlands
- U - upland woodlands
- E - edges
- H - areas of human habitation

[3]Season:
- R - Resident: Occurring regularly in the same general area through the year; Implies breeding.
- SR - Summer Resident: Implies breeding but may include non-breeders.
- WR - Winter Resident: Occurring during the winter season.
- M - Migrant: Occurs as a transient passing through the area either in spring or fall, or both.
- V - Visitor: Does not occur in numbers large enough or with frequency great enough to be considered a seasonal resident, but is not unexpected.
- C - Casual: Might be expected to occur once in ten years on the average.

- A - abundant - species easily found in large numbers in proper habitat during survey.
- C - common - species easily found in proper habitat during survey although in lesser numbers than above.
- U - uncommon - species which were hard to find even in proper habitat or which occurred locally in only a few areas.

[4]General reconnaissance survey conducted 6-7 March 1979.

Table 11

Bird Densities--Riparian Woodland--Fort Hood

Species*	FALL Strip Width(m)	FALL No.	FALL No./ 100ha	SPRING Strip Width(m)	SPRING No.	SPRING No./ 100ha
Tufted Titmouse	50	24	177.6	50	18	240.0
Cardinal	50	17	125.8	75	16	142.2
Carolina Chickadee	50	12	88.8	--	--	--
White-eyed Vireo	50	10	74.0	--	--	--
Yellow-billed Cuckoo	40	7	65.1	40	4	66.7
Wilson's Warbler	30	5	64.0	--	--	--
Summer Tanager	40	4	37.2	--	--	--
Carolina Wren	100	10	37.0	--	--	--
Black-and-white Warbler	40	2	18.6	--	--	--
Blue-gray Gnatcatcher	40	2	18.6	--	--	--
Bewick's Wren	50	2	14.8	--	--	--
Downy Woodpecker	50	2	14.8	--	--	--
Ladderbacked Woodpecker	50	2	14.8	40	1	33.3
Red-bellied Woodpecker	50	2	14.8	50	2	26.7
Canyon Wren	30	1	12.8	--	--	--
Yellow-bellied Flycatcher	30	1	12.8	--	--	--
Northern Oriole	40	1	9.3	--	--	--
Eastern Wood Pewee	50	1	7.4	--	--	--
Brown Towhee	50	1	7.4	--	--	--
Mourning Dove	50	1	7.4	100	11	73.3
Great-tailed Grackle	--	--	--	80	13	216.7
Redwinged Blackbird	--	--	--	200	28	186.7
Eastern Meadowlark	--	--	--	100	10	133.3
Brown-headed Cowbird	--	--	--	150	12	106.6
Lark Sparrow	--	--	--	60	4	88.9
Mockingbird	--	--	--	100	6	80.0
Bobwhite	--	--	--	120	6	66.7
Indigo Bunting	--	--	--	100	4	53.3
Scissor-tailed Flycatcher	--	--	--	80	3	50.0
Chimney Swift	--	--	--	100	2	26.7
Green Heron	--	--	--	100	1	13.3
Great Blue Heron	--	--	--	200	1	7.3

*For an explanation of terminology in table headings, see the appendix.

Table 12

Bird Densities--Deciduous-Juniper Woodland--Fort Hood

	FALL			SPRING		
Species*	Strip Width(m)	No.	No./ 100ha	Strip Width(m)	No.	No./ 100ha
Carolina Chickadee	50	28	61.6	60	6	166.7
Cardinal	50	15	33.0	100	13	216.7
Tufted Titmouse	50	14	30.8	100	12	200
White-eyed Vireo	50	9	19.8			
Blue-gray Gnatcatcher	30	4	14.8	80	8	166.7
Wilson's Warbler	40	4	11.2			
Mourning Dove	50	5	11.0			
Bewick's Wren	40	3	8.4			
Yellow-billed Cuckoo	50	3	6.6			
Ladder-backed Woodpecker	50	2	4.4			
Black-and-white Warbler	30	1	3.7	60	7	194.4
Black-capped Vireo	30	1	3.7			
Carolina Wren	100	1	1.1			
Indigo Bunting				100	2	33.3
Eastern Meadowlark				100	2	33.3
Brown-headed Cowbird				100	7	116.7
Turkey Vulture				1000	8	13.3
Field Sparrow				150	1	11.1
Rufous-sided Towhee				80	1	20.8
Ruby-throated Hummingbird				40	1	41.7
Lark Sparrow				30	1	55.6
Empidonax Flycatcher				80	2	41.6

*For an explanation of terminology in table headings, see the appendix.

Table 13

Bird Densities--Juniper Woodland--Fort Hood

	FALL			SPRING		
Species*	Strip Width(m)	No.	No./ 100ha	Strip Width(m)	No.	No./ 100ha
Cardinal	50	21	121.8	150	15	133.3
Carolina Chickadee	50	7	40.6			
Bewick's Wren	50	6	34.8			
Tufted Titmouse	50	4	23.2	100	3	40.0
Rufous-crowned Sparrow	40	3	21.9			
Mourning Dove	50	3	17.4	200	8	53.3
Blue-gray Gnatcatcher	50	2	11.6			
Hummingbird sp.	30	1	9.7			
Ladder-backed Woodpecker	50	1	5.8			
Carolina Wren	50	1	5.8			
White-eyed Vireo	100	1	2.9	100	1	13.3
Common Crow	250	2	2.4	400	1	3.3
Red-bellied Woodpecker				100	3	40.0
Turkey				150	2	17.8
Brown-headed Cowbird				60	2	44.4
Mockingbird				200	1	26.7
Lark Sparrow				80	1	16.7
Rough-legged Hawk				200	1	26.7
Bobwhite				100	1	13.3
Turkey Vulture				400	2	6.7
Black Vulture				600	1	2.2

*For an explanation of terminology in table headings, see the appendix.

Table 14

Bird Densities--Grazed Grassland--Fort Hood

	FALL			SPRING		
Species*	Strip Width(m)	No.	No./100ha	Strip Width(m)	No.	No./100ha
Bobwhite	100	18	39.6	100	5	11.4
Lark Sparrow	50	6	26.6	100	12	27.4
Mockingbird	100	6	12.4	150	12	53.3
Field Sparrow	100	2	4.4	100	2	4.6
Mourning Dove	150	3	4.4	200	8	26.7
Cardinal	100	2	4.4	150	5	22.2
Carolina Chickadee	150	1	1.5			
Tufted Titmouse				200	3	10.0
Eastern Meadowlark				150	11	48.9
Savannah Sparrow				40	3	50.0
Scissor-tailed Flycatcher				200	6	20.0
Brown-headed Cowbird				150	4	17.8
Red-bellied Woodpecker				150	1	4.4
Turkey				150	2	8.9
Summer Tanager				100	2	4.6

*For an explanation of terminology in table headings, see the appendix.

Table 15

Bird Densities--Disturbed Woodland--Fort Hood

	FALL			SPRING		
Species*	Strip Width(m)	No.	No./ 100ha	Strip Width(m)	No.	No./ 100ha
Cardinal	50	15	200.0	200	11	36.7
Lark Sparrow	40	3	50.0	100	5	33.3
Carolina Chickadee	100	3	20.0	80	1	8.3
Painted Bunting	40	1	16.7			
Mockingbird	100	2	13.3	200	5	16.7
Mourning Dove	250	1	2.7	100	7	46.7
Scissor-tailed Flycatcher	250	1	2.7			
Yellow-billed Cuckoo				100	2	13.3
Eastern Meadowlark				200	4	13.3
Brown-headed Cowbird				80	4	33.3
Tufted Titmouse				150	3	13.3
American Goldfinch				40	1	16.7
Black-capped Vireo				80	1	8.3
Great Blue Heron				80	1	8.3
Field Sparrow				60	2	22.2
Common Crow				400	1	1.7
Turkey				400	1	1.7
Turkey Vulture				200	1	3.3

*For an explanation of terminology in table headings, see the appendix.

Table 16

Bird Densities--Road-Cruise Census--East Side, Fort Hood

Species*	FALL			SPRING		
	No.	% Frequency	No./km	No.	% Frequency	No./km
Cardinal	91	70.0	2.26	70	90.0	2.85
Carolina Chickadee	35	30.0	0.87	3	10.0	0.12
Mourning Dove	30	34.0	0.75	40	73.3	1.63
Turkey Vulture	27	12.0	0.67	7	13.3	0.28
Mockingbird	17	20.0	0.42	36	60.0	1.46
Black Vulture	13	4.0	0.32	15	10.0	0.61
Lark Sparrow	9	4.0	0.22	33	53.3	1.34
Eastern Bluebird	8	4.0	0.20	--	--	--
Killdeer	8	6.0	0.15	17	10.0	0.69
Least Sandpiper	8	2.0	0.20	--	--	--
Downy Woodpecker	6	12.0	0.15	1	3.3	0.04
Tufted Titmouse	6	8.0	0.15	26	50.0	1.06
Solitary Sandpiper	5	2.0	0.12	--	--	--
White-eyed Vireo	5	10.0	0.12	--	--	--
Great Egret	4	2.0	0.10	--	--	--
Green Heron	4	4.0	0.10	--	--	--
Common Crow	3	2.0	0.07	5	13.3	0.20
Roadrunner	3	2.0	0.07	--	--	--
Scissor-tailed Flycatcher	3	2.0	0.07	4	13.3	0.16
Bobwhite	2	6.0	0.05	3	6.7	0.12
Common Grackle	2	2.0	0.05	--	--	--
Eastern Meadowlark	2	2.0	0.05	38	56.7	1.55
Great Blue Heron	2	4.0	0.05	--	--	--
Yellow-billed Cuckoo	2	2.0	0.05	--	--	--
Belted Kingfisher	1	2.0	0.02	--	--	--
Bewick's Wren	1	4.0	0.02	1	3.3	0.04
Little Blue Heron	1	2.0	0.02	--	--	--
Red-bellied Woodpecker	1	2.0	0.02	8	13.3	0.33
Summer Tanager	1	2.0	0.02	9	16.7	0.37
Yellow Warbler	1	2.0	0.02	--	--	--
Field Sparrow	--	--	--	11	30.0	0.45
Rufous-sided Towhee	--	--	--	3	10.0	0.12
Brown-headed Cowbird	--	--	--	51	40.0	2.07
Turkey	--	--	--	7	16.7	0.28
American Robin	--	--	--	1	3.3	0.04
Rough-winged Swallow	--	--	--	4	10.0	0.16
Veery	--	--	--	1	3.3	0.04
Redwinged Blackbird	--	--	--	1	3.3	0.04
Hairy Woodpecker	--	--	--	1	3.3	0.04
Empidonax Flycatcher	1	2.0	0.02	1	3.3	0.04

*For an explanation of terminology in table headings, see the appendix.

Table 17

Bird Densities--Road-Cruise Census--West Side, Fort Hood

	FALL			SPRING		
Species*	No.	% Frequency	No./km	No.	% Frequency	No./km
Cardinal	43	46.0	1.22	79	85.0	2.59
Carolina Chickadee	25	24.0	0.62	1	2.5	0.03
Turkey Vulture	25	20.0	0.62	6	7.5	0.18
Mockingbird	18	22.0	0.45	73	77.5	2.23
Tufted Titmouse	13	14.0	0.32	27	40.0	0.82
Eastern Meadowlark	12	8.0	0.30	50	50.0	1.53
Turkey	11	2.0	0.27	3	7.5	0.09
Lark Sparrow	10	8.0	0.25	48	52.5	1.46
Killdeer	9	4.0	0.22	13	20.0	0.40
Mourning Dove	9	12.0	0.22	36	47.5	1.10
Bobwhite	8	8.0	0.20	8	12.5	0.24
Black Vulture	6	2.0	0.15	--	--	--
Downy Woodpecker	6	8.0	0.15	--	--	--
White-eyed Vireo	4	4.0	0.10	--	--	--
Belted Kingfisher	2	4.0	0.05	--	--	--
Bewick's Wren	2	4.0	0.05	1	2.5	0.03
Summer Tanager	2	2.0	0.05	3	4.0	0.09
Chimney Swift	1	2.0	0.02	--	--	--
Common Crow	1	2.0	0.02	--	--	--
Lesser Goldfinch	1	2.0	0.02	--	--	--
Loggerhead Shrike	1	2.0	0.02	--	--	--
Scissor-tailed Flycatcher	1	2.0	0.02	8	8.0	0.24
Yellow-billed Cuckoo	1	2.0	0.02	2	5.0	0.06
Lincoln's Sparrow	--	--	--	1	2.5	0.03
Redwinged Blackbird	--	--	--	81	27.5	2.47
Field Sparrow	--	--	--	11	17.5	0.34
Rufous-sided Towhee	--	--	--	14	15.0	0.43
Song Sparrow	--	--	--	2	5.0	0.06
Brewer's Blackbird	--	--	--	22	5.0	0.67
Marsh Hawk	--	--	--	1	2.5	0.03
Say's Phoebe	--	--	--	1	2.5	0.03
Brown-headed Cowbird	--	--	--	15	10.0	0.46
Cedar Waxwing	--	--	--	8	2.5	0.24
Great-tailed Grackle	--	--	--	31	5.0	0.95
Blue-gray Gnatcatcher	--	--	--	1	2.5	0.03
White-throated Sparrow	--	--	--	2	5.0	0.06
Unidentified Sp.	2	2.0	0.05	--	--	--

* For explanation of terminology in table headings, see the appendix.

Table 18

Mammals--Fort Hood

Common Name*	Scientific Name	General Habitat	Observed in Project Area
Virginia opossum	Didelphis virginianus	F,G,S	X
Eastern mole	Scalopus aquaticus	sandy areas	
Least shrew	Cryptotis parva	G	
Cave bat	Myotis velifer	caves, buildings	
Eastern pipistrelle	Pipistrellus subflavus	F,S	
Big brown bat	Eptesicus fuscus	F, buildings, caves rocky areas	
Hoary bat	Lasiurus cinereus	F	
Red bat	Lasiurus borealis	F	
Brazilian free-tailed bat	Tadarida brasiliensis	F,S	
Big free-tailed bat	Tadarida macrotis	rocky areas, caves, buildings	
Raccoon	Procyon lotor	S	XO
Ringtail	Bassariscus astutus	rocky areas, woodlands	
Mink	Mustela vison	S	
Long-tailed weasel	Mustela frenata	F,G	
Eastern spotted skunk	Spilogale putorius	F,G	
Striped skunk	Mephitis mephitis	F,G	X
Badger	Taxidea taxus	G	
Red fox	Vulpes fulva	F	
Gray fox	Urocyon cinereoargenteus	F	X
Coyote	Canis latrans	G,F	X[a]
Mountain lion	Felis concolor	brushy deer habitat	
Bobcat	Lynx rufus	F, rocky area	X[a]
Mexican ground squirrel	Spermophilus mexicanus	brushy or grassy areas	
Fox squirrel	Sciurus niger	F	XO
Southern flying squirrel	Glaucomys volans	F	
Plains pocket gopher	Geomys bursarius	G	
Merriam pocket mouse	Perognathus flavus	shortgrass sandy soils	O
Hispid pocket mouse	Perognathus hispidus	sandy soil, G	
Beaver	Castor canadensis	S	
Fulvous harvest mouse	Reithrodontomys fulvescens	G	XO
Plains harvest mouse	Reithrodontomys montanus	G	O
Northern pygmy mouse	Baiomys taylori	G	O
Deer mouse	Peromyscus maniculatus	G,F	XO
White-footed mouse	Peromyscus leucopus	F	
Texas mouse	Peromyscus attwateri	cliffs, rocky outcrops	O
White-ankled mouse	Peromyscus pectoralis	cliffs, rocky outcrops	O
Hispid cotton rat	Sigmodon hispidus	G	X

*For an explanation of terminology in table headings, see the appendix.

Table 18 (Cont'd)

Common Name	Scientific Name	General Habitat	Observed in Project Area
Eastern woodrat	Neotoma floridana	G,F	X
House mouse	Mus musculus	human constructions, G	
Black rat	Rattus rattus	human constructions	
Norway rat	Rattus norvegicus	human constructions, G	
Nutria	Myocastor coypus	S	
Black-tailed jack rabbit	Lepus californicus	G	XO
Eastern cottontail	Sylvilagus floridanus	brushy areas and edges	XO
Collared peccary	Pecari tajacu	brushland	
White-tailed deer	Odocoileus virginianus	brush, G	XO
Axis deer	Axis axis	F	
Nine-banded armadillo	Dasypus novemcinctus	brush, FG	XO

Source: Davis (1974), Beaty (2978a); nomenclature follows Jones et al. (1973).

Comments:
S - aquatic associated habitats
G - grasslands and open areas
F - forest and woodlands
X - observed during fall 1978
O - observed during spring 1979

[a]Species captured by Fish and Wildlife Section trappers during the period 1 March 1977 - 1 March 1978.

Table 19

Small Mammal Trapping--Fort Hood

Species*	Number Trapped/Habitat															
	Juniper Woodland		Riparian Woodland		Mixed Deciduous Juniper Woodland		Disturbed Woodland		Grazed Grassland		Ungrazed Grassland		Food Plot		Total	
	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S
Merriam pocket mouse								5								5
Fulvous harvest mouse				1							1				1	1
Plains harvest mouse				1						1						2
Northern pygmy mouse		1														1
Deer mouse	39		1	2	42		7		1		1		1		92	2
Texas mouse		2				25		36				2				65
White-ankled mouse		3				20		13		2		1				39
Hispid cotton rat					1						5				6	
Eastern woodrat	1				2										3	
Eastern cottontail								1								1
Total	40	6	1	4	45	45	7	55	1	3	7	3	1	--	102	117
Trapnights	196	150	105	161	249	2120	150	2205	238	154	120	154	40	--	1098	4944
Trapnights/catch	4.9	25	105	40.3	5.5	47.1	21.4	40.1	238	51.3	17.1	51.3	40	--	10.8	42.6
Percent Success	20.4	4.0	0.95	2.5	18.1	2.1	4.7	2.5	0.4	1.9	5.0	1.9	2.5	--	9.3	2.3

*For an explanation of terminology in table headings, see the appendix.

Table 20

Mammals--Nocturnal Road-Cruise Census--Fort Hood

Species*	Fall		Spring	
	Number Observed	Number/km	Number Observed	Number/km
White-tailed deer	7	0.11	21	0.36
Black-tailed jack rabbit	6	0.09	1	0.02
Northern raccoon	6	0.09	1	0.02
Gray fox	2	0.03	0	--
Eastern cottontail	1	0.02	9	0.16
Fox squirrel	1	0.02	0	--
Nine-banded armadillo	0	--	1	0.02
	23	0.36	33	0.57

*For an explanation of terminology in table headings, see the appendix.

Table 21

Endangered, Threatened, and Peripheral Vertebrates--
Potential Occurrence--Fort Hood

Common Name*	Scientific Name	Status		
		TOES	IPWD	USDI
(Interior) Least Tern	Sterna albifrons athalossos	-	E	-
White-faced Ibis	Plegadis chihi	T	-	-
Roseate Spoonbill	Ajaia ajaja	P	-	-
Fulvous Whistling Duck	Dendrocygna bicolor	E	-	-
Bald Eagle	Haliaeetus leucocephalus	E	E	E
Golden Eagle	Aquila chrysaetos	T	-	-
Osprey	Pandion haliaetus	E	-	-
Peregrine Falcon	Falco peregrinus	E	E	E
Prairie Falcon	Falco mexicanus	T	-	-
Merlin	Falco columbarius	T	-	-
Golden-cheeked Warbler	Dendroica chrysoparia	E	-	-
Mountain lion	Felis concolor	E	-	-

*For an explanation of terminology in table headings, see the appendix.

Source:
TOES - Texas Organization for Endangered Species (1975)
TPWD - Texas Parks and Wildlife Department (1977)
USDI - U.S. Department of the Interior (1977)

Comments:
E - Endangered
T - Threatened
P - Peripheral

4 AQUATIC COMMUNITIES

Fort Hood Military Reservation lies entirely within the Brazos River Basin. The streams draining the reservation tend to flow easterly. From north to south, the major drainages are the Leon River, Owl Creek, Cowhouse Creek, Nolan Creek, and Reese Creek. All of these except Reese Creek and Nolan Creek flow into Belton Lake. Reese Creek flows into the Lampasas River, while Nolan Creek flows into the Leon River below Belton Lake (Figure 7). Of these, Cowhouse Creek can be considered the major drainage on the reservation.

USGS gauging stations are maintained on the Leon River above and below the reservation at Gatesville and Belton, Texas. Gauges are also maintained on Nolan Creek at Belton, Texas, and on Cowhouse Creek at Pidcoke, Texas, immediately upstream from the reservation. Only stream discharge data are available from these stations. Water quality data are available from a USGS gauging station located in Belton Lake. These data indicate that the reservoir water is moderately hard and slightly alkaline in pH. Neither large oxygen saturation deficits nor excessive amounts of nitrogen and phosphorus have been reported, indicating that the water is of good quality. No unusual quantities of dissolved constituents are apparent from these data.

A water quality study[48] using biological indicators was conducted by the U.S. Army Environmental Hygiene Agency. On the basis of samples collected in Cowhouse Creek and its tributaries, this study concluded that the effluent from the Copperas Cove sewage treatment plant was affecting Turkey Run, a tributary of Cowhouse Creek. It also concluded that the primary impact of tactical training resulted from physical disturbance and siltation in Cowhouse Creek, which limited the available habitat area for some species.

A report on a pesticide monitoring program at Fort Hood[49] showed that pesticide concentrations tended to be higher in impounded waters within the military reservation or in streams originating on the reservation, rather than in those streams traversing it. Somewhat increased concentrations of pesticides were found in fish tissue samples in comparison to the sediments, indicating that some accumulation was taking place.

Aquatic Habitats

A preliminary reconnaissance for the fall survey of aquatic habitats at Fort Hood was conducted on 9 and 10 August 1978, and the sampling program was conducted between 21 and 25 August 1978. Figure 7 shows station locations. Because of the general deficit in precipitation during the 1976-1978 period, the level of Belton Lake was down considerably during the fall survey. Henson Creek

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48 U.S. Army Environmental Hygiene Agency, Aquatic Organisims as Indicators of Water Quality, Water Quality Biological Study No. 24-002-75 (U.S. Army Environmental Hygiene Agency, 1974).

49 U.S. Army Environmental Hygiene Agency, Pesticide Monitoring, Department of the Army Pesticide Monitoring Program, Evaluation of Environmental Samples Collected in Calendar Year 1975, Annual Report No. 44-0100-78 (U.S. Army Environmental Hygiene Agency, 1977).

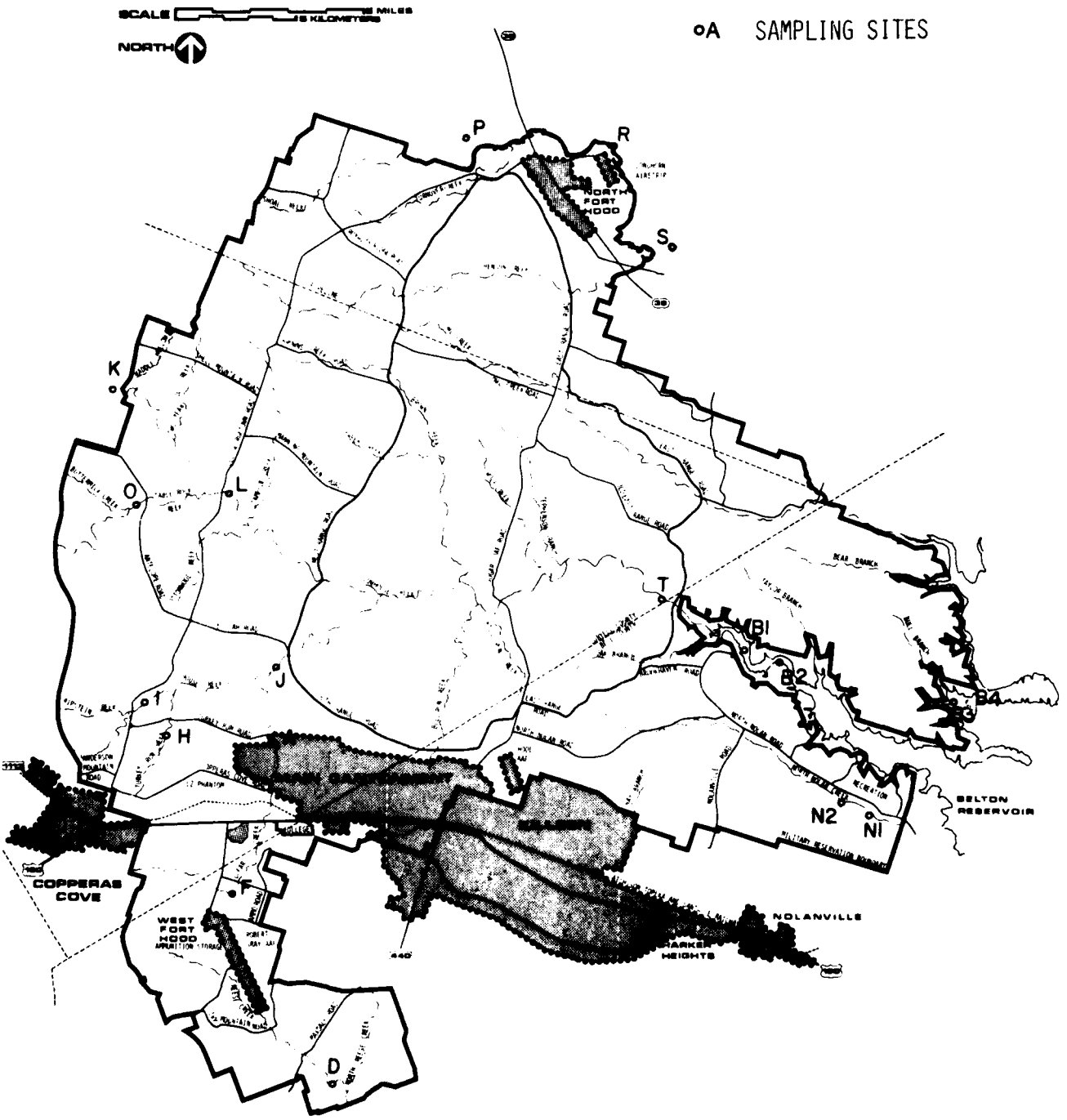

Figure 7. Aquatic sampling sites.

and Owl Creek were dry at all crossings examined, as were the smaller tributaries of the other creeks. Flowing water was observed during the survey only in lower Clear Creek, Turkey Run, and Upper House Creek (Stations A, H, and I, respectively). All other stream stations, including Cowhouse Creek and the Leon River, consisted of isolated pool habitats. With one exception, no difference in the presence or absence of flow or water level was observed between the reconnaissance survey and the major field survey. The only exception was Cowhouse Creek at Curry Crossing (Station T), where the water level was estimated to have risen some 30 to 40 cm between the reconnaissance survey and the time it was sampled during the field survey, probably as a result of a thunderstorm on 21 August. No change was noted at the West Range Road crossing of Cowhouse Creek. The spring survey was conducted between 7 and 11 May 1979. All stations contained flowing water because of the spring rains.

Table 22 presents water quality parameters measured during the fall survey. The sampling sites on Clear Creek (Stations F and A) were somewhat different, since the upper Station (F) was a pool, while the lower Station (A) was flowing. The number of taxa increased by only two at the lower station, while that station had more than double the density of organisms of the upper station. Between Stations F and A, Clear Creek receives runoff from the western portion of the Main Cantonment Area, a sanitary landfill, and a golf course. While Station A did not exhibit depressed numbers of species, a calculated diversity would be low, due to the extreme dominance of Euglena sp. at this station. The relatively high water temperatures observed during the survey are apparently normal for this season. The somewhat lower values for some of the creek stations probably reflect the degree of shading by riparian vegetation. Relatively low dissolved oxygen values were found in Clear Creek, North Nolan Creek, and House Creek. This seems to have been due more to the turbidity and shading characteristics of these stations than to heavy organic loading. Conductivities were high at all stations except D on Reese Creek. While pH values were often above 8.0 in Belton Lake, they were only slightly alkaline at all creek stations. Table 23 shows water quality parameters for the spring survey. Conductivities remained high at all stations, although they were lower than in the fall survey. The pH values showed that most stations were slightly alkaline. No low dissolved oxygen readings were recorded in the spring. Night measurements at Stations K and T indicated acceptable dissolved oxygen levels in Cowhouse Creek.

The following paragraphs describe the physical and chemical nature of the habitats sampled along with general observations on their biology. The stations are divided into seven groups based on the fall survey: Belton Lake, Leon River, Cowhouse Creek, flowing streams (lower Clear Creek, lower Turkey Run, upper House Creek), non-flowing streams (mid Table Rock Creek, lower North Nolan Creek, upper North Nolan Creek, upper Clear Creek, lower Reese Creek, and lower House Creek), and ponds and marshes. A seventh group established in the spring consisted of Turnover Creek, Henson Creek, and Owl Creek. These stations were not sampled in the fall. Tables 24 and 25 summarize some of the major characteristics of the habitats sampled at each station.

Belton Reservoir

Two sampling stations (B1 and B2) were established at the upstream end of the Cowhouse Creek arm of Belton Reservoir. Two control stations (B3 and B4) were established in similar areas (with respect to depth, proximity to shore,

and the presence of stands of inundated trees) in the cove immediately to the north of the Cowhouse Creek arm. Although this cove receives drainage from a portion of the Fort Hood Military Reservation, the drainages are small in area and were dry at the time of the fall survey. The drained area shows far less human use than is typical of the region either on or off the military reservation.

The effects of siltation from Cowhouse Creek were evident in the upper portions of this arm of Belton Reservoir. Extensive flats of a very soft gray clay were found at Station B1. This clay layer was approximately 40 cm deep over a hard surface on which there was a layer of largely undecayed bermuda grass, indicating that this sedimentation had occurred recently. A similar clay was present at Station B2 at a depth of 8 m. The substrate at Station B3 (depth = 1 m) was mud and organic detritis of terrestrial origin over rock. At Station B4, the substrate consisted of fine gravel at a depth of 14 m.

Leon River

Sampling stations were located on the Leon River at points upstream (Station R) and downstream (Station S) of Fort Hood. Both stations consisted of isolated pool habitats that were heavily shaded in a deeply cut stream channel. Abundant growths of filamentous algae and various higher aquatic plants were evident at both stations on the Leon River. During the spring survey, both Leon River stations were flowing rapidly. Sampling was difficult at both stations due to the flow. Station R, a control station upstream which receives no drainage from the reservation, was dammed on the upstream side by the low water bridge. The area upstream of Station S consisted of the northernmost portion of Fort Hood, including the North Fort Hood Cantonment and its attendant storm drainage and sewage treatment facilities, the northern portion of the impact area, and a small portion of the northern part of the maneuver training area.

Cowhouse Creek

In the fall, Cowhouse Creek was sampled at Station K at the confluence of Cowhouse and Bee House Creeks just upstream of the western boundary of Fort Hood (control station), at Station L in the middle of the maneuver training area, and at Station T at Curry Crossing where Cowhouse Creek emerges from the impact area. All three stations were pool habitats, with Station K showing the greatest apparent habitat diversity. In the spring survey, Station K was moved from the confluence of Cowhouse and Bee House Creeks to just inside Fort Hood because of the inaccessibility of the former Station K. This station consisted of steep-cut banks, with a bottom of rock and gravel having soft sediment and detritus along the shore. All other stations were at the same location. All three Cowhouse Creek stations were flowing in the spring. Substrate types at Station K ranged from mud to rubble. Stands of rooted aquatic vegetation were present, as well as a considerable amount of organic detritus. Station L consisted of a series of small pools. The stream bed consisted of rock slabs having holes and cracks filled with considerable amounts of silt. Large stands of Chara sp. were present in these small pools as were large numbers of very small fishes. This station receives drainage from large areas used extensively for training. Station T at Curry Crossing was the largest pool habitat sampled in the fall. This pool was backed up by a concrete low-water bridge. In the spring the low-water bridge was inundated by water, the station was flowing. Substrate here consisted entirely of soft mud having a depth of 20 to 30 cm over

a rock bottom. This station receives the drainage from the central portion of the impact area and receives runoff from the Main Cantonment Area of Fort Hood by way of drainage through Black and Jackson Gaps (Bull Run). Station I bottom type changed to fine gravel or sand in the pools and to rocks in the riffles. This is probably due to deposition after the spring rains.

Fall Flowing Streams

The flowing stream systems were sampled at Stations A (lower Clear Creek), H (lower Turkey Run Creek), and I (upper House Creek). Collections were made in both pool and riffle areas at all three sites. Station A at Clear Creek contained a riffle and pool having a bottom consisting of mud and organic detritus with numerous stands of aquatic macrophytes and floating mats of filamentous blue-green algae. Station H on Turkey Run consisted of a pool and riffle system largely free of aquatic macrophytes or large masses of filamentous algae. Station I on House Creek nad a slab and rubble bottom and was choked by large masses of the filamentous green alga, Hydrodictyon sp. Although all three stations still consisted of pool and riffle systems, the flow was increased over what it had been in the fall. Only Station H contained large amounts of filamentous algae in the spring. Stations H and I drain the maneuver training areas and receive urban runoff and/or sewage discharges from sources outside the Fort Hood Military Reservation. During the spring survey, this station was flowing.

Upper Clear Creek (Station F) consisted of a pool habitat in a gravel stream bed. A considerable amount of trash was present at the lower end of this pool in the fall, but no trash was noted in the spring. No significant stands of aquatic macrophytes or filamentous algae were present at this station, since it was shaded relatively heavily.

Fall Non-Flowing Streams

The non-flowing stations included mid Table Rock Creek (Station O), lower North Nolan Creek (Station N1), upper North Nolan Creek (Station N2), upper Clear Creek (Station F), lower Reese Creek (Station D), and lower House Creek (Station J). All of these stations were flowing in the spring.

Station O on Table Rock Creek in the fall was a small remnant pool remaining after the evaporation of a much more extensive isolated pool. The substrate was primarily rock slab covered by a thick layer of silt. This station had good flow in the spring. The smell of H_2S was evident. The drainage area of this station includes a large area used extensively for maneuver training.

Station N1 on North Nolan Creek was a small shallow pool in fall. Although this pool had a deep, soft mud bottom, the stream bed was rock both up- and downstream of the pool. Aquatic macrophytes and filamentous algae were absent from this station in the fall. Station N2 on North Nolan Creek was a considerably larger pool, having a substrate consisting largely of fine gravel with smaller admixtures of mud and organic detritus. Both stations contained more water than in the fall and were flowing in the spring survey. Both stations appeared to be located in an area used lightly for maneuver training. These stations are also adjacent to the Belton Lake Recreation Area North Nolan Creek receives sewage discharge from the treatment plant located there.

Station F on Clear Creek drains the built-up area around Robert Gray Army Airfield. Farther down Clear Creek, Station A also receives runoff from the housing facilities to the west of the Main Cantonment Area.

Station D on Reese Creek in the fall was an extremely turbid, shallow pool in a stream bed consisting of gravel, cobbles, and boulders. The pool was well shaded and enclosed in very steep stream banks. In the spring, this station was flowing. H_2S bubbles were noted as well as decreased turbidity from the fall. Neither filamentous algae nor aquatic macrophytes were present at this station in the fall survey. Station D on Reese Creek drains an area primarily used for bivouac. This area gives the appearance of being used much less heavily than the maneuver training areas west of the West Range Road.

Station J on House Creek was an artifically impounded, shallow, mud-bottom pool in the fall. Although large, this pool was heavily shaded. The mud bottom overlapped a rock stream bed and did not contain a large amount of organic detritus. No significant stands of aquatic macrophytes were present. In the spring, Station J increased in depth. Flow was slow and over the impoundment.

Fall Dry Streams

Three stations with flowing water were sampled in the spring; all of these stations were dry during the fall. The stations sampled were Station Z - Owl Creek, Station Y - Henson Creek, and Station P - Turnover Creek.

Owl Creek (Station Z), which drains the eastern-most section of the impact area, consisted of shallow pools and riffles with rock and gravel bottoms. Henson Creek (Station Y) was a pool and riffle system consisting of steep banks with an open canopy. The water was shallow with good flow, and the bottom consisted mostly of solid rock covered in places by a thin layer of silt. This station drains the northern part of the impact area. Turnover Creek (Station T) was a pool and riffle system draining part of the northern-most section of Fort Hood. The pools contained sand bottom, and the riffles consisted of rock and gravel. Flow was slow, the water was clear, and the canopy was open.

Ponds, Springs and Marshes

Standing water habitats at Fort Hood were limited to numerous small impoundments (stock ponds and Soil Conservation Service flood control lakes). No marsh areas of significance were found. The stock ponds are managed to some extent in order to provide a recreational fishing resource; however, the biota of these ponds were not sampled, since they are managed as a fishery resource and adequate characterization data are already available.

Detention ponds have been constructed along the northern perimeter of the Main Cantonment Area to trap runoff, particularly the vehicle parks and maintenance areas. Overflow from these detention ponds reaches an area from Cowhouse Creek through Bull Run (Figure 7).

Aquatic Biota

The results of the biological sampling program are presented in the following sections. The Appendix presents methods and materials for each organism group.

Phytoplankton

Table 26 lists the phytoplankton taxa and the estimated density of each at all stations sampled during the fall survey. It also lists the total number of taxa and the total density estimated at each station. Table 27 presents the results of the spring survey.

In the fall, Cowhouse Creek (Stations K and T) and Table Rock Creek (Station O) had the largest number of taxa, with 41, 42, and 40, respectively. Lower Reese Creek (Station D) and upper House Creek (Station I) had the fewest taxa, with 10 and 12, respectively. An average of 30 taxa were collected at the other 12 stations. The total number of taxa in the phytoplankton increased during the spring (97 taxa identified in spring, compared with 88 in fall). (The greater diversity of diatoms suggests that some may have been scoured from benthic substrates.) During the spring survey, upper House Creek (Station I), upper Nolan Creek (Station N2), Belton Reservoir (Station B3), mid Cowhouse Creek (Station L), lower Nolan Creek (Station N1), lower Cowhouse Creek (Station T), and lower Clear Creek (Station A), had the largest number of taxa, with 38, 36, 36, 35, 34, 32, and 32, respectively. Samples from the Leon River Stations (Station R and Station S) contained no phytoplankton due to flushing caused by the spring rains. An average of 22 taxa were collected at the other 12 stations.

The number of taxa observed in the House Creek stations during the fall survey increased from 12 to 30 between Station I (flowing) and Station J (pool). While this might be attributed to the influence of the supposedly nutrient-rich Turkey Run (Station H) and Clear Creek (Stations F and A), the total density of organisms did not increase significantly; however, the reverse occurred in the spring survey. The number of taxa had decreased from Station I to Station J. Station I contained 38 taxa, whereas Station J contained 29. The density also decreased significantly. Turkey Run (Station H), influenced by the Copperas Cove sewage treatment plant, exhibited a blue-green algal population less than that of upper House Creek (Station I), which has no known point source of enrichment. However, during the fall survey, Station H exhibited a greater blue-green algal population than Station I. The sampling sites on Clear Creek (Stations F and A) were somewhat different since the upper station (F) was a pool, while the lower station (A) was flowing. The number of taxa increased by only two at the lower station, although that station had more than twice the density of organisms of the upper station. The spring survey showed an increase of five taxa between Stations F and A, although Station A still contained twice the density of Station F. Between Stations F and A, Clear Creek receives runoff from the western portion of the Main Cantonment Area, a sanitary landfill, and a golf course. While Station A did not exhibit a decreased number of species, a calculated diversity would be low, due to the extreme dominance of Euglena sp. during the fall survey. The relatively high phytoplankton density at this station, due largely to the

presence of the pollution-tolerant genus Euglena,[50] suggests that this portion of Clear Creek is being impacted by current polluting practices. In the spring survey, the dominance of diatoms at this station resulted from the flushing actions of the spring rains. Station J, located below the confluences of both Turkey Run and Clear Creek, shows some evidence of enrichment. The numbers of phytoplankton taxa and the density observed at Station J are nearly average for the reservation, although five relatively tolerant taxa[51] accounted for nearly 75 percent of the total phytoplankton. In the spring, the density was below average, whereas the number of taxa was above average. This was due to an increase in diatoms.

The outfall of the Belton Lake Recreation Area sewage treatment plant into North Nolan Creek could not be positively located during the field survey; the plant was apparently not discharging at that time. Based on the observed phytoplankton community, neither North Nolan Creek Station (N1 or N2) appeared to be enriched heavily.

Reese Creek (Station D) was the only sampling site during the fall survey that contained neither blue-green algae nor green algae (Chlorophyta) (Table 27). The absence of these taxa, combined with the fact that 88 percent of the population of only 10 taxa was composed of an unidentified euglenoid-type organism, made this a typical "stressed" situation. In all probability, the stress was due mostly to the extreme turbidity and heavy shading at this station. The spring survey showed a dominance of diatoms as well as the occurrence of blue-green and green algae. The lack of the euglenoid type of algae as well as the dominance of the diatoms was due to flooding.

Within the Cowhouse Creek drainage system, phytoplankton populations were generally dominated by green algae (Tables 28 and 29). Two exceptions were Stations I (upper House Creek) and A (lower Clear Creek). Upper House Creek was dominated by diatoms (Bacillariophyta), which were 86 percent of the total population in the fall and 71 percent in the spring; lower Clear Creek was dominated by euglenoid cells which formed 88 percent of the population in the fall and by diatoms, which formed 68 percent of the population in the spring. Exactly half of the eight sampling sites within the Cowhouse Creek drainage system were dominated by the group described as "miscellaneous green algae" (Table 8) in the fall survey. These algal cells were so small that they could not be identified positively beyond the division level. This group is an important food source of various zooplankton species.[52] The other stations not dominated by the miscellaneous green algae were usually dominated or subdominated by members of the chlorococcales, particularly the genus Scenedesmus. The chlorococcales are generally characteristic of small bodies of water.

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50 M. C. Palmer, "A Composite Rating of Algae Tolerating Organic Pollution," J. of Phycology, No. 5 (1969), pp 78-82.

51 M. C. Palmer, "A Composite Rating of Algae Tolerating Organic Pollution," J. of Phycology, No. 5 (1969), pp 78-82; R. L. Lowe, Environmental Requirements and Pollution Tolerance of Fresh Water Diatoms (Nation. Env. Res. Ctr., USEPA, Cincinnati, 1974).

52 F. Ruttner, Fundamentals of Limnology (Univ. of Toronto Press, 1966).

Outside the Cowhouse Creek drainage (North Nolan Creek, Reese Creek, and the Leon River), the sampling stations in the fall survey were dominated and/or subdominated by flagellated algae of the divisions Euglenophyta, Chrysophyta, and Cryptophyta (Table 27). These algal forms are also characteristic of small bodies of water. Forms such as Euglena sp., Trachelomonas sp., and Lepocinclis sp. often occur in alkaline water which is generally rich in nutrients, particularly when nitrogen, phosphorus, and organic content are high.[53]

Dominant populations changed between the fall and spring surveys. The dominance of the diatoms (Bacillariophyta) at all stations other than Belton Reservoir (Stations B1, B2, B3, and B4), upper Cowhouse Creek (Station T), and lower Cowhouse Creek (Station K) was the result of the spring rains. Dominant algae in Belton Reservoir changed from blue-greens to the Cryptophyta. Overall phytoplankton densities were lower in the spring survey than in fall 1978 (Tables 22 and 23), except at Station T where densities increased several times (12 614/ml in fall compared with 63 061/ml in spring). Flushing of smaller creeks into Cowhouse Creek as well as backwater from Lake Belton could be responsible for higher densities at this station. The most dramatic reduction in phytoplankton densities due to flushing occurred at the Leon River Stations R and S where no algae were observed in the samples.

The most significant difference in phytoplankton occurred between the various drainage systems and Belton Lake. Within the reservoir itself, the sampling sites showed an increase in the proportion of blue-green algae in the total community and a decrease in the proportions of both the Chlorophyta and Euglenophyta. Although Stations B1 and B2 are located in a cove influenced by the Cowhouse Creek watershed and B3 and B4 are in another cove that has no significant runoff, their phytoplankton populations are similar (Tables 30 and 31). The miscellaneous green algae (Table 29) was the dominant green algal group at all reservoir sampling sites during the fall. With reference to the blue-green algae, all stations were dominated by Spirulina sp., and three of the four had Schizothrix sp. as a subdominant in the spring (Table 32). Creek drainage system seems to have had little or no influence on the phytoplankton populations within the reservoir during the survey.

Periphyton

The 112 species of attached diatoms collected at Fort Hood (Table 33) can generally be described as having a cosmopolitan distribution and requiring water of neutral pH; best growth occurs slightly above a pH of 7.[54] Diatoms for which there is information are characteristic of water having high nutrient concentrations and/or conductivity. Also included are at least two common soil species (Hantzschia amphioxys and Navicula mutica) which are easily introduced into aquatic habitats.

The Cowhouse Creek drainage system (including tributaries) seems to be dominated in the fall by Nitzschia palea and Cyclotella meneghiniana. In all but one case (lower House Creek, Station J), one of these species was the

[53] F. E. Round, The Biology of the Algae (Edward Arnold LTD, London, 1966).
[54] R. L. Lowe, Environmental Requirements and Pollution Tolerance of Fresh Water Diatoms (Nation. Env. Res. Ctr., USEPA, Cincinnati, 1974).

dominant or subdominant form. In lower House Creek, N. amphibia replaced N. palea as a subdominant. The genus Nitzschia is frequently associated with nutrient-rich situations.[55] Both N. palea and C. meneghiniana occur frequently in areas heavily damaged by organic pollution;[56] however, this does not indicate that N. palea and C. meneghiniana have strict requirements for highly enriched water, but rather that they are more tolerant of such conditions.[57] N. palea was the dominant form along Cowhouse Creek (Table 34). This, and the fact that the total number of diatom species at both upper and lower Cowhouse Creek stations was almost identical (Table 35), seems to indicate that neither point sources nor non-point sources of pollution greatly affect the attached diatom populations of Cowhouse Creek. In the spring, the Cowhouse Creek drainage system was dominated by Cocconeis pediculus. Gomphonema parvulum was a subdominant at mid Cowhouse Creek (Station L).

G. parvulum was found in large numbers in areas receiving both treated and raw sewage.[58] This species occurred in Turkey Run, lower House Creek, and lower Cowhouse Creek, all downstream from known sewage discharges. However, G. parvulum also occurred in Table Rock Creek and in upper House Creek and constituted a larger proportion of the attached diatom community than it did at the stations immediately below sewage discharges. Thus, the organic loading of the Cowhouse Creek system seemed to be widespread and not confined to areas downstream from sewage treatment plants.

Effects of point source pollution might be indicated by the reduction of total species number between upper and lower House Creek stations as a result of the inflow of Turkey Run and Clear Creek (Tables 33 and 34). Caution must be used in this assessment, however, because the total species number was reduced by almost one half between upper and middle Cowhouse Creek stations for no apparent reason. A similar situation occurred in the Leon River, where total species number was reduced from 52 at the upper station to 15 at the lower station in the fall. Reduction in species number between these stations could conceivably have been caused by localized seasonal environmental conditions, as in the spring.

The North Nolan Creek Station N1 (lower) contained both N. palea and C. meneghiniana at very low densities, and contained Anomoeoneis vitrea as the dominant form in the fall and Cocconeis placentula as the dominant in the spring. While this is not indicative of a pristine condition, neither is it an indication of gross pollution. N. amphibia was the subdominant in the fall. Table 35 shows that N. amphibia was the dominant form below the sewage treatment plant at Turkey Run (Station H) as well as in North Nolan Creek in

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55 R. Patrick, "Ecology of Freshwater Diatoms and Diatom Communities," pp 284-332, In: D. Werner (ed.), The Biology of Diatoms (Blackwell Scientific Publ., London, 1977).

56 J. H. Olive and J. L. Price, "Diatom Assemblages of the Cuyahoga River, N.E. Ohio (USA)," Hydrobiologia, No. 57 (1978), pp 175-187.

57 R. L. Lowe and J. M. McCullough, "The Effect of Sewage Treatment Plant Effluent on Diatom Communities in the North Branch of the Portage River, Wood County, Ohio," Ohio I. Sci., No. 74 (1974), pp 154-161.

58 R. L. Lowe and J. M. McCullough, "The Effect of Sewage Treatment Plant Effluent on Diatom Communities in the North Branch of the Portage River, Wood County, Ohio," Ohio I. Sci., No. 74 (1974), pp 154-161.

the fall. Thus, North Nolan Creek appears to show some effect from the discharge at the Belton Lake Recreation Area sewage treatment plant.

The attached diatom community within the study area was dominated by species which show a wide tolerance to environmental conditions. For example, N. palea the fall dominant, occurs in streams where the pH ranges from 3.8 to 8.5.[59] Within a drainage system like Fort Hood's, seasonal change could affect the populations of attached diatoms much more dramatically than minor land use changes. The periphyton diatom populations observed at these stations did not differ substantially from what would be expected in similar habitats in the central Texas region.

Periphyton data presented in Tables 34 and 36 demonstrated an increase in the number of taxa between fall and spring. Although species composition was not identical, many of the same taxa were identified. The dominant species changed, with the most abundant taxon overall in spring being C. pediculus and N. palea and C. meneghiniana in the fall. The changes from fall to spring seem to be more in response to local conditions (e.g., fall drought vs. spring floods) than to changes in organic loading from point or nonpoint sources.

Macrophytes

Macrophytes were present in pools of all the larger drainages at Fort Hood, including the Leon River (Stations R and S), Cowhouse Creek (Stations K, L, and T), House Creek (Stations I and J), Clear Creek (Stations A and F), and North Nolan Creek (Station N2), but were absent from the smaller creeks (Table 24) during the fall survey. Chara sp. (stonewort), a macroalga, was present in all these creeks except House and North Nolan Creeks and was particularly dense at Station L on Cowhouse Creek. Vascular macrophytes collected included Lemna sp. (duckweed), which formed a floating mat completely covering the surface of one pool at Station S; Najas guadalupensis (common water-nymph), a submerged aquatic, which was found in pools in several creeks; Myriophyllum sp. (water milfoil), also a submerged aquatic, found only at Station N2; Sagittaria platyphilla (arrowhead), an emergent found mainly along margins at Station A; and Bacopa rotundifolia, an emergent found along margins in several streams.

Of the aquatic macrophytes collected at Fort Hood, Chara sp. was the most widespread in spring, as it had been in the fall (Table 37). Some marginal vegetation which had been inundated by high water was collected. In addition, some species not observed during the fall survey were collected from a seep along the bank of Nolan Creek (Station N1). Macrophytes collected in the spring survey, but not observed in the fall included Justicia americana (American Waterwillow), Eleocharis montevidensis (Spikerush), Potamogeton (Pondweed), Samolus parviflorus (Water Pimpernel), Veronica (Speedwell), and Zannichellia palustris (Common Poolmat).

The major value of macrophytes to aquatic environments is shelter for fishes, insects, and crustaceans. Macrophytes also provide substrates for periphyton, on which many macroinvertebrates graze. Submerged macrophytes can

[59] F. D. Hancock, "The Ecology of the Diatoms of the Klip River," Southern Transval., Hydrobiologia, No. 42 (1973a), pp 243-284.

contribute substantially to daytime DO levels, as observed in Pool 2 at Station L (Table 23), but excessive growth may cause nighttime DO depletion. Unattached or loosely attached macrophytes are often swept downstream during seasonal floods.

Zooplankton

Tables 38 and 39 present the estimated density of each zooplankton taxon at each station, the total number of taxa identified, and a summary of the total estimated density for each station. Tables 40 and 41 summarize the relative abundance of major zooplankton groups at each station.

Rotifers were the primary groups at the four Belton Lake stations, comprising 99.0, 100.0, 89.8, and 89.2 percent during the fall, and 70.8, 81.1, 86.9 and 49.8 percent in the spring at Stations B1, B2, B3, and B4, respectively. In the fall survey, 13 of 14 species collected were rotifers at Stations B1 and B4; at Station B2, all species collected were rotifers, and at Station B3, 10 of 14 species were rotifers. Most of the rotifers observed at the Belton Lake stations during both surveys were characteristically planktonic forms or those frequently found in lacustrine environments. These include Brachionus sp., Conochilus unicornis, Conochiloides dossuarius, Filinia longiseta, Hexarthra mira, Keratella cochlearis, Polyarthra vulgaris, Synchaeta pectinata, S. stylata, Ploesoma hudsoni, Anuraeopsis fissa, and Trichocerca sp.[60] Species of the genus Brachionus, restricted to alkaline waters,[61] were common in Belton Lake, where pH values ranged from 7.1 to 8.6.

No cladocerans were collected from any of the Belton Lake stations in the fall, but some were found in the spring survey. Although they made up less than 10 percent of the populations at Stations B1, B2, and B3, they made up 25.5 percent of the population at Station B4. Copepods represented a small percentage of the organisms captured; naupliar larvae were the only copepod instars observed during the fall survey. Copepods remained a small percentage of the organisms captured during the spring survey at Stations B1, B2, and B3; however, at Station B4, copepods made up 24.4 percent of the population. Of the four Belton Lake stations during the fall survey, B4 possessed the greatest zooplankton density with 294 organisms/L, while the lowest density observed (114 organisms/L) was at B3 (Table 32). The spring survey showed that Station B3 had the greatest abundance of zooplankton (215 organisms), whereas the lowest density was at Station B1 (129 organisms). The differences may be due partly to differences in water clarity.[62] Density was highest at Station B4, which had the clearest water (Secchi disk reading of 164 cm compared to 23, 64, and 61 cm at Stations B1, B2, and B3, respectively). This relationship did not recur in the spring survey, when the reading for Station B3 was 78 cm, and 134 cm for B1.

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60 G. E. Hutchinson, A Treatise on Limnology, Vol II (John Wiley and Sons, 1967).

61 E. H. Ahlstrom, "A Revision of the Rotatorian Genera Brachionus and Platyias With Descriptions of One New Species and Two New Varieties," Bull. Amer. Mus. Nat. Hist., Vol 77 (1940), pp 143-184.

62 L. G. Williams, "Dominant Planktonic Rotifers of Major Waterways of the United States," Limnol. Oceanogr., No. 11 (1966), pp 83-91.

Overall, zooplankton densities at Belton Lake stations were moderate to low, with correspondingly low phytoplankton densities at the same locations (Tables 26 and 27) during both surveys. The zooplankton community observed in Belton Lake is similar to that of other reservoirs in this region at that time of year.[63]

During the fall, rotifers represented 92 percent of the zooplankton community on the upper Leon River (Station R), while copepods comprised 7 percent (Table 40). No cladocerans were observed at Station R. In contrast, on the lower Leon River (Station S) copepods were the primary group (64 percent), while rotifers and cladocerans represented 28 percent and 7 percent, respectively. The spring survey showed a decrease in rotifers at Station R (49 percent), whereas copepods increased to 39 percent (Table 41). At Station S, rotifers increased in importance to 50 percent of the total, diptera increased to 40 percent.

The species compositions of the two Leon River stations were quite different. The sample from Station R, in addition to exhibiting a higher density (7945 organisms/L compared to 1325 organisms/L at Station S), was dominated by small-bodied rotifers, probably because it was a grab sample, and not filtered through a net. Many organisms that might ordinarily pass through the 64-micron mesh of the net were thus retained. The most abundant rotifers at Station R were the Trichocerca sp. These species are found mainly in productive ponds[64] or macrophyte zones, although some are definitely planktonic.[65] Station S was dominated by nauplii and immature cyclopoid copepods. Both Leon River stations exhibited relatively high densities of these species, which are often associated with ponds or pools where a no-flow or long detention time regime allows populations to increase. At both stations, diverse food supplies may also have contributed to the zooplankton density. Species compositions of the Leon River stations included both planktonic and littoral species, which is typical of shallow pools having a variety of microhabitats. Variable zooplankton populations (by species composition and abundance) are often noted in such intermittent stream situations. At the Leon River stations, this was probably the result of operant factors inherent in pond and intermittent stream environments (e.g., variety of habitat, diversity of food supply, fluctuation of water levels, little or no flow).

The species composition of the Leon River stations changed in the spring survey. At Station R, the rotifers decreased in dominance, and at Station S,

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63 B. B. Harris and J. K. G. Silvey, "Limnological Investigations on Texas Reservoir Lakes," Ecol. Monogr., No. 10 (1940), pp 211-143; J. R. MacRae and B. Maguire, Jr., Before and After Studies of the Effects of a Power Plant Installation on Lake Lyndon B. Johnson; Before Studies, Vol. 1, Monitoring Data, Progress Report No. 3 to Lower Colorado River Authority, Contract IAC (74-75) 1089 (Lower Colorado River Authority, 1975).

64 G. E. Hutchinson, A Treatise on Limnology, Vol II (John Wiley and Sons, 1967).

65 A. Ruttner-Kolisko, Plankton Rotifers Die Binnengewasser, Vol 26, Part 1 (E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, 1974).

the rotifers increased to 50 percent of the sample. The decrease at Station R can be attributed primarily to the use of a 64-micron mesh net to filter the sample. The decrease in density of both stations (7945 in fall compared to 53 in spring at Station R, and 1325 in fall compared to 40 in spring at Station S) was primarily the result of the flood conditions.

Lower Clear Creek (Station A), Turkey Run (Station H), and upper House Creek (Station I) were the only stations which had running water during the fall field survey. These stations had relatively low densities, ranging from 294 organisms/L at upper House Creek to 508 organisms/L at lower Clear Creek. This was probably a result of flow; for example, the non-flowing upper Clear Creek had a density of 3287 organisms/L or approximately six times the density of lower Clear Creek. No flow was observed at upper Clear Creek, which may account for the higher density. In a pond, where no current is evident, detention time is greater than in moving water, enabling the development of a denser zooplankton community. In addition, lower Clear Creek was somewhat more turbid than upper Clear Creek, and turbidity tended to limit zooplankton densities. In addition, small ponds consist of both littoral and limnetic regions,[66] which provide a variety of habitats and food sources. This allows the development of communities that include both planktonic and littoral species, which contribute to higher densities.

Rotifers dominated the catch at all three stations in the fall. Each had a diverse assemblage of both riverine and littoral rotifer species, as expected in a pool-riffle system. The community at Station H on lower Turkey Run, which receives effluent from Copperas Cove, was not noticeably affected by this input. The three stations with flow (A, H, and I) were among the most diverse in terms of numbers of taxa, although absolute abundances were not high. Stations A, H, and I (lower Clear Creek, Turkey Run Creek, and upper House Creek, respectively) still contained running water during the spring survey. Overall densities at all three stations were lower due to the spring flood, and rotifers dominated at all three locations.

Of the remaining creek stations sampled, all were isolated pools in the fall like Leon River. Upper Cowhouse Creek (Station K) had a zooplankton density of 1306 organisms/L, while lower Cowhouse Creek (Station T) had a relatively low density (382 organisms/L) in the fall. Neither of these stations had flowing water. Reasons for the disparity in densities are unclear, since there was not a corresponding major difference in phytoplankton densities at these two stations. Both of these stations exhibited a zooplankton assemblage consisting primarily of species typically found in lentic habitats. During the spring survey, upper Cowhouse Creek (Station K), mid Cowhouse Creek (Station L) and lower Cowhouse Creek (Station T) had low densities (3, 1, and 57, respectively). The low densities reflect the effects of spring rains. Lower Cowhouse Creek (Station T), which has the greatest density, reflects the effect of longer retention time.

Table Rock Creek (Station O) exhibited a very high density of 4481 organisms/L in the fall, as did upper Clear Creek (Station F), which had 3287 organisms/L. Since these were pool habitats, the high densities were expected. The spring sampling showed the effect of the spring flood, with

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66 R. E. Coker, Streams, Lakes, and Ponds (Harper and Row, 1954).

densities at both Station O and Station F decreasing (1 organism/ml and 30 organisms/ml, respectively).

Both stations sampled on North Nolan Creek (N1 and N2) during the fall had high densities in relation to all other stations sampled. This may be partly because 1-gallon grab samples were taken at these locations, thus retaining small organisms that would have otherwise passed through a 64-micron plankton net. The high densities may also be due to the nature of the habitats (isolation and reduced predation). Station N1, with a total density of 23,776 organisms/L (Table 32), was a shallow pool with no flow, populated mainly by ubiquitous planktonic rotifer species and some copepods, mainly nauplii. Station N1 may have been receiving some enrichment from organic wastes from cattle in the area and from the outfall of the Belton Lake Recreation Area sewage treatment plant (Figure 7). Station N2, with a density of 8445 organisms/L, was populated mainly by a few species of rotifers and copepod nauplii. Fewer species were noted here than at other stations.

The spring survey at the Nolan Creek Stations (N1 and N2) showed a decrease from the fall for densities for two reasons: (1) the spring survey used a 64-micron plankton net which would have allowed many small organisms to pass through, and (2) the flow caused by the spring flood caused a further decrease by flushing.

Station D on lower Reese Creek had a density of 407 organisms/L, with copepods the most abundant group during the fall. A large number of the predaceous dipteran larvae (Chaoborus sp.) were collected in the sample at Station D. Chaoborus sp., along with the high turbidity, might have influenced the community's population density. Deonier[67] found that Chaoborus sp. was a voracious predator of all types of zooplankton. In the spring survey, the overall density of zooplankton decreased due to the flowing conditions. Lower House Creek (Station J), Owl Creek (Station Z), Henson Creek (Station Y), and Turnover Creek (Station P) were not sampled in fall because they were dry. The stations were sampled in the spring. All had low densities (1 to 3 organisms/ml), as expected.

Overall zooplankton densities at most stations were extremely low in the spring except in Belton Lake, where densities were similar to those observed in the fall (Tables 38 and 39). Sixty-eight taxa were identified, including some of the same species found in the fall, when 74 taxa were collected. Rotifers continue to be the most abundant and diverse group as in the fall. Keratella cochlearis, Polyarthra vulgaris, and Copepod nauplii remain the most widespread and abundant taxa overall, although other species dominated at some stations in the spring.

Macroinvertebrates

The results of macroinvertebrate sampling at all stations are presented in Tables 42 and 43 (density estimates from dredge and Surber samples) and Tables 44 and 45 (collections by dip net).

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67 C. C. Deonier, "Biology of the Immature Stages of the Clear Lake Gnat," Ann. Ent. Soc. Amer., No. 36 (1943), pp 383-388.

Benthic samples collected at Belton Lake in the fall (Stations B1, B2, B3, and B4) consisted entirely of Diptera, which were primarily the predaceous Tanypodinae (Table 35). Coelotanypus sp. was the most abundant taxon at all stations except B4, where Polypedilum illinoense and Tanypus stellatus were codominants. Substrates at B1, B2, and B3 were fine clay, as compared with fine gravel at B4. Light penetration was also much greater at Station B4. These differences may account for the presence of Polypedilum illinoense, since members of this genus are typically algal grazers.

Species diversity was low at all Belton Lake stations, particularly at Station B1.[68] Here, the deep, apparently recently accumulated clay sediment layer may account for the low diversity. The highest diversity was at B3, where sediments contained a large amount of organic detritus. Standing crop was low at all reservoir stations, but was highest (4181/m^2) at B2. This station had sediments similar to those of B1, but was probably less silted, since it is located farther from the mouth of Cowhouse Creek. High water prevented collection at the Belton Lake stations in the spring.

In the fall the benthic community at upper Leon River (Station R) was primarily Diptera (55 percent) and Oligochaeta (41 percent). This relatively high abundance of worms, particularly Tubificids, is indicative of organic pollution.[69] The dominant Diptera were the same Tanypodinae that were abundant in Belton Lake. The dominant oligochaetes included immature Tubificidae and Branchiura sowerbyi. B. sowerbyi is thought to be an introduced species, and is known to be tolerant and may even prefer warm water, since it has been observed in a variety of thermal regimes in temperate lakes and streams.[70]

Species diversity in benthic samples was higher at Station R in comparison with most creeks. Diversity was 2.425, and 19 taxa were collected. The standing crop at Station R was 2157/m , which was higher than in most creeks, but lower than in Belton Lake. Quantitative samples were not taken in the spring survey at Stations R and S because of the depth, increased flow, and change in bottom type.

The number of taxa collected by dip net in the fall at Leon River Stations R and S was the same as was taken in the quantitative samples (Table 44). This was somewhat less than the number collected from most other creeks at Fort Hood. Although similar in diversity, the macroinvertebrate assemblages were somewhat different between these two stations. Plumatella repens (Bryozoa) and Orthotrichia sp. (Trichoptera) were found only at one other station (Station A), and Spongilla sp. (Porifera) was collected only at Station R. Several of the taxa collected at Station R are usually found in flowing water, although no flow was recorded during the August 1978 survey. Most freshwater sponges are intolerant of silt, and their presence at Station R reflects the relatively unsilted condition of this station.

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68 C. E. Shannon and W. Weaver, The Mathematical Theory of Communication (University of Illinois Press, 1949).

69 R. O. Brinkhurst, "Taxonomical Studies on the Tubificidae (Annelida, Oligochaeta)," Int. Rev. Ges. Hydrobiol. Suppl., No. 51 (1966), pp 727-742.

70 R. O. Brinkhurst, "Taxonomical Studies on the Tubificidae (Annelida, Oligochaeta)," Int. Rev. Ges. Hydrobiol. Suppl., No. 51 (1966), pp 727-742.

Dip net collections in the spring survey at Leon River stations showed a decrease in the number of taxa (7 in the spring as compared to 76 in the fall). This low number is indicative of the effects of the spring floods.

Taxa found at Leon River Station S in the fall but not at Station R include the Conchostraca (Lynceus sp.) and Crustacea (Hyalella azteca and Palaemonetes sp.) (Table 44). The Conchostraca are indicative of temporary pools, while the other Crustacea are detritivores commonly found in weedy habitats. More detritus occurred on the bottom at Station S than at Station R. Pools at Station S, being much smaller than those at R, might also be less permanent. Species adapted to lotic (running water) habitats at Station R were mostly absent from Station S, possibly indicating lower flows during wet seasons at Station S. This observation is supported by the presence of finer substrates (muck and detritus) at Station S when compared with Station R (fine gravel), and the greater abundance of algae and macrophytes, which would tend to be swept away in higher flows. The possibility of greater nutrient enrichment at Station S might also account for the abundant growth of macrophytes.

Macroinvertebrates collected by dip net at Cowhouse Creek include species tolerant of a wide range of environmental conditions (Table 44). Most are typically found in the quiet waters of streams, lakes, and ponds. Differences in macroinvertebrate assemblages at various stations are attributable to differences in substrates and food sources at the Cowhouse Creek stations. These differences are exemplified by the variety of mayfly taxa found at each station in the fall. Caenis sp. and Stenonema tripunctatum, found at Station K, inhabit quiet water, cling to rocks or woody debris, and are tolerant of silt. Both feed on algae (including diatoms) and detritus.[71] These species were also found at Station L, along with Baetis sp. and Callibaetis sp. The greater diversity of mayflies at Station L may be attributed to the abundance of Chara sp. at this station. Hexagenia bilineata, found only at Station T, is a burrower in bottom sediments. Station T was the only one on Cowhouse Creek where a deep sediment layer occurred. This was primarily due to runoff from nearby unvegetated areas.

In the fall survey, Cowhouse Creek Station K supported fewer taxa (9) than Stations L or T (21 and 19, respectively) (Table 44). The abundance of Chara sp. at Station L probably contributed significantly to the diversity of habitats at this station.

The spring survey showed a decrease in the total number of taxa collected. Eight taxa were collected by dip net from both Stations K and L. The decrease in taxa, particularly at Station L, can be attributed to the spring floods. Quantitative taxa samples were taken at Station L during the spring survey. Only three taxa, consisting of 21 organisms/m were collected. The calculated diversity at this station was low.

Flow was detected during the fall at creek Stations A, H, and I. At Turkey Run Creek (Station H), the base flow is from sewage discharge from

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[71] B. D. Burks, "The Mayflies or Ephemeroptera of Illinois," Ill. Nat. Hist. Surv. Bull., No. 26 (1953); G. F. Edmunds, Jr., S. L. Jensen, and L. Berner, The Mayflies of North and Central America (Univ. of Minn. Press, Minneapolis, 1976).

Copperas Cove, while at lower Clear Creek (Station A) and upper House Creek (Station I) flow presumably comes from natural sources.

Surber samples were collected in the fall survey in riffles at Stations H and I and exhibited very low standing crops, particularly at H (120/m^2). The sandy substrate where Surber samples were collected at Station H probably provides a less stable habitat for macroinvertebrates than does the gravel substrate at Station I. Possible effects of the sewage effluent discharged to this creek from Copperas Cove cannot be discounted. However, species diversities at these stations were among the highest collected at Fort Hood and were comparable to those at Leon River Station R. The dominant group at both stations was Diptera; other important groups collected in riffles included the Oligochaeta, Odonata, Hemiptera, and Coleoptera at Station H, and the Oligochaeta and Gastropoda at Station I.

Surber samples were taken at all three stations during the spring survey. An Ekman dredge sample was also taken at lower Clear Creek Station (Station A). All stations supported a lower number of taxa than in the fall. The diversity of Station H showed a dramatic increase from 0.2336 in the fall to 1.767 in the spring. The Oligochaeta was the dominant group at this station, although the Diptera were subdominant. At Station A, the diversity index slightly decreased to 2.024 from 2.493 in the fall. Diptera remained the dominant group. Quantitative results from Station A at upper Clear Creek showed the differences in both sample technique and bottom types. The Ekman samples, which were taken from areas where the jaws of the dredge could close, such as muddy bottom areas, showed a diversity of 1.4648, with 3275 organisms/m^2. These organisms came from 20 taxa and were dominated by the Oligochaeta. The Surber samples, which were taken from shallow riffles, showed a diversity index of 1.7465, based on 1331 organisms/m made up of 20 taxa. These were dominated by the Diptera.

Dip net collections at Stations A, H, and I included the highest numbers of taxa found at Fort Hood. Clear Creek Station A had the highest number of taxa (40), probably because of its diversity of habitats, including the rock riffle and the soft-bottomed pool which contained an abundance of macrophytes. Several taxa, including Corydalus sp., Psephenus sp., Plumatella repens, and Orthotrichia sp., found at Stations A, H, or I during the July 1978 survey, are adapted to flowing water habitats and attach themselves to rocks or woody debris in currents. In the spring survey, the dip net collections from Stations A, H, and I showed a decrease in the number of taxa from fall. The loss of the number of species in the spring is at least partially accounted for by the spring flood. The remaining creek stations sampled, like Leon River, were isolated pools.

Benthic samples were taken only at Station T on Cowhouse Creek in the fall due to the lack of fine substrates at Cowhouse Creek Stations K and L (Table 26). The standing crop (8836/m^2) and diversity (1.997) were high at Station T in comparison with most other stations at Fort Hood (Table 42). Community composition was similar to other creeks, with about 62 percent Oligochaeta and 35 percent Diptera. As in the Leon River, some organic enrichment of Cowhouse Creek is indicated by the high proportion of oligochaetes and the low number of most insect orders. Because of the spring flooding, only dip net samples were taken at Station T in the spring. Dominance at Station T was evenly divided between the Ephemeroptera, Diptera and the Hemiptera.

Quantitative benthic samples were collected at Stations 0, N1, N2, F, D, and J, all of which had no flow recorded during the 21 through 25 August 1978 aquatic survey. Standing crops of benthos at Stations 0, N1, N2, F, D, and J ranged from a low of 1749/m^2 at Station N2 to 11,163/m^2 at Station 0. Standing crops in creeks were generally higher than in Belton Lake. The minimum (at Station N2) was similar to Leon River Station R, and the maximum (at Station 0) was similar to Cowhouse Creek Station T. These stations are discussed together because of their similarity with respect to lack of flow.

In the spring, quantitative benthos samples were taken at Stations 0, N1, N2, D, J, P, and Z. Unlike the fall survey, all of these stations had flowing water in the spring. The standing crop ranged at these sites from 10,746 organisms/m^2 at Station J (lower House Creek) to a low of 612 organisms/m^2 at Station Z (Owl Creek). Station J was pooled behind a low dam and was made up of 87 percent Oligochaeta.

Diptera and Oligochaeta were the dominant taxonomic groups in natural substrate samples due to the fine sediments and leafy detritus occurring at most of these creek stations. Oligochaeta comprised at least 50 percent of the benthic community in the fall at Stations N1, N2, D, and J, and less than 50 percent at Stations 0 and F. The higher percentage (86 percent) of oligochaetes at Station J, in comparison with other stations is attributable to the permanent nature of the pool formed by a dam on House Creek. The dominant Oligochaeta were the same as those collected from the Leon River and Cowhouse Creek Stations R and T. Diptera was the dominant group at Stations 0 and F, having a relative abundance greater than 50 percent at each of these stations. The dominant species of Diptera were generally the same as those collected in Belton Lake, although additional species were found in creeks.

Diptera and Oligochaeta dominated all stations (0, N1, N2, J, P, and Z) during the spring survey; however, at Station D, the Gastropods dominated.

During the fall, species diversity of these non-flowing stations ranged from 1.464 at N1 to 2.238 at F. Diversity at Stations 0, N1, N2, F, D, and J was generally higher than at Belton Lake but lower than at Stations R and T. The lowest diversities occurred at Stations 0, J, and N1. Station C, with six taxa, and Station N1, with nine taxa, appeared to be somewhat stressed aquatic habitats. Low water levels caused by a late summer drought were particularly evident at these stations. Station 0 was heavily silted from erosion and had a very concentrated fish population because of the low water level. Station N1 had a very soft bottom which evidently had been disturbed frequently by cattle. This well-shaded station is near the sewage outfall of the Fort Hood Recreation Area sewage treatment plant. Organic nutrient loading and lack of light probably account for the low DO levels measured here (Table 23).

Species diversity in the spring ranged from 0.882 at Station 0 (mid Table Rock Creek) to 2.598 at Station N1 (Nolan Creek). The lower number of taxa varied from a low of 10 at Station Z (Owl Creek) to a high at Station N2 of 23. Stations 0, J, P, and Z were dominated by Oligochaeta. Nolan Creek stations were dominated by the Diptera.

Taxa collected by dip net at pooled-up stations ranged in number from 9 at Station N1 to 26 at Station F. The most widespread and abundant groups collected were the Oligochaeta (worms), Arachnida (water mites), Amphipoda (scuds),

Ephemeroptera (mayflies), Odonata (dragonflies, damselflies), Coleoptera (beetles), Diptera (flies), and Gastropoda (snails). Most of the taxa collected are tolerant of a wide range of conditions and are commonly found in quiet water, especially among vegetation or detritus. Caenis sp., the most common mayfly collected, occurs in silted streams and feeds on detritus and algae. A total of 18 taxa of Odonata were collected, including bottom sprawlers, burrowers, and slender forms which cling to vegetation and wood. All members of this group are predaceous on other invertebrates, and are typically found in quiet pools. Gastropods collected were all members of the subclass Pulmonata, which breathe by means of a pulmonary sac. This enables them to withstand low DO levels like those often occurring in shallow nutrient-enriched pools. Except at Station N1, the macroinvertebrate assemblages in these intermittent creeks appeared to be fairly diverse and typical of the locality and the season.

Dip net collections for the spring survey at Stations P, O, N1, N2, D, J, Y, A, and Z contained between nine and 22 taxa. Station P (Turnover Creek) and Station D (lower Reese Creek) contained nine taxa, whereas Station N2 (lower Nolan Creek) contained 22 taxa. The Crustacea, Ephemeroptera, Odonata, Trichoptra, Hemiptera, Diptera, and Gastropoda were the most widespread and abundant groups collected in the spring.

Overall macroinvertebrate samples collected by Ekman dredge and Surber samples were less diverse in the spring than in the fall survey (64 taxa in the fall compared with 54 in the spring). Although many of the same taxa were collected (Tables 42 and 43), densities were lower at most stations in spring, although the silty substrate at Station J supported a more abundant Oligochaete population, and total densities were higher at this station. Although Dipteras were still an important group in terms of abundance, they were considerably less abundant and diverse in benthic samples taken in spring than in the fall. Macroinvertebrates collected by dip net were also less diverse in the spring (67 taxa in the spring compared with 109 in the fall) as shown in Tables 44 and 45). Inundation of rock riffles and scouring of substrates probably account for much of the decrease in diversity. Many of the taxa identified in the spring were the same as those observed in the fall.

Fish

Little published information is available for describing Fort Hood's fish communities. Beaty[72] includes a checklist of the fish known to occur in the waters of the Little Lampasas and Leon Rivers, Nolan Creek, and Belton and Stillhouse Hollow Reservoirs. His list is compiled from records of periodic fish surveys made by the Texas Parks and Wildlife Department, Austin, TX.

Table 46 lists fish that could potentially occur at the Fort Hood Military Reservation, as well as those actually collected on-site. Of the 64 species which may occur in the area, 29 were collected at one or more of the 14 stations in the fall. Most of these (26 species) were collected in the small intermittent creeks; 13 species were collected in Belton Lake, and six in the Leon River. This was probably a result of unequal collection effort being expended in each of these water body types (i.e., 11 stations were in

[72] H. E. Beaty, A Checklist of Flora and Fauna in Central and West Bell County, Texas, unpublished manuscript (3414 Forest Trail, Temple, TX, 1978a).

intermittent creeks, two were in Belton Reservoir, and one was in Leon River), as well as increased diversity of habitat types in the large number of intermittent creeks.

The spring survey collected 26 taxa; of these, only three were collected in the spring that had not been collected in the fall. Ictiobus bubalus, smallmouth buffalo, Morone chrysops, the white bass, and the Lepomis humilis, the orange-spotted sunfish, were the additional taxa found in the spring. Most were collected in either Cowhouse Creek (14 species) or the intermittent creeks (14 species). Twelve were collected in Belton Reservoir, and seven were collected in Leon River. The differences are the result of both unequal collection effort at each type of water body, and in the sampled stations' different habitats.

Seining produced 26 species in the fall, and shocking and gill netting added three more. The species collected by gill netting were the longnose gar (Lepisosteus osseus), carp (Cyprinus carpio), and flathead catfish (Pylodictus olivaris). The most common species collected by gill netting and shocking were the gizzard shad (Dorosoma cepedianum) (25), followed by channel catfish (I. punctatus) (11), and longnose gar (L. osseus) (9). These species are common at a 25-year-old reservoir.

Twenty-three species were collected in Cowhouse Creek, Leon River, and the intermittent creeks by seining, and 12 species were collected in Belton Reservoir by electroshocking and gill netting. Of the 12, only three were unique to Belton. C. carpio (carp), I. bubalus (smallmouth buffalo), and M. chrysops (white bass).

Table 47 presents the results (number collected, weights, and lengths) of the fish collected by seining in the fall survey for each of the 14 stations. Approximately 12,000 fish were collected during the field surveys. Most (72 percent) of these were collected at Station 0 in mid Table Rock Creek (6645) and at Station A on lower Clear Creek (1966). The numbers of fish collected per station were fairly evenly distributed among the rest of the stations except at Belton Reservoir Station B1, where only 27 individuals were collected.

Table 48 gives the results of the spring survey, in which approximately 1800 fish were collected. This reduction (down from 12,000 in fall) is to be expected, because the fall survey was conducted when most of the station samples were remnant pools having little or no flow between them. The drought conditions would have forced fish to move to these pools and concentrated in them. However, the spring flood, while stressing the populations, would reopen the stream and allow the fish to move to other areas of the stream reach.

Although considerable variability was evident in species composition, richness, and density among the stations sampled, no consistent relationships were apparent between these parameters of the fish community and the stations' various physical or ecological characteristics. Differences in water quality or sediment loadings did not produce consistent differences in fish faunas. Likewise, substrate type, general morphometry, and presence or extent of macrophytes appeared to significantly affect the fish communities. No consistent relationship was apparent between fish community parameters and distance up the watershed, although evidence of Belton Lake's influence was

at Station T on Cowhouse Creek, where Tidewater Silverside (Menidia beryllina), a lake species, was present in the fall survey.

The most commonly collected species in the fall was the mosquitofish (Gambusia affinis). This species represented approximately 65 percent of all fish collected. In addition, this species accounted for approximately 78 percent of the fish collected at mid Table Rock Creek (Station O) and 82 percent of those collected at lower Clear Creek (Station A). These two stations were ranked first and second in total number of individuals collected, simply because these collections contained large numbers of mosquitofish. High concentrations of mosquitofish are common in shallow, protected areas because of the concealment provided by these areas (i.e., protection from larger predators) and their tolerance (relative to other species) of stressful conditions.

The second and third most commonly collected species were the red shiner (Notropis lutrensis) and bluegill (Lepomis macrochirus). These two species accounted for an additional 16 percent of the 12,000 fish collected. Most of the red shiners were collected at either upper or lower House Creek (Stations I and J), while most of the bluegills were collected at mid Table Rock Creek (Station O). The remaining 23 species collected by seining account for the remaining 19 percent of the fish. The most commonly collected fish in Belton Reservoir was the long-nosed gar (Lepisosteus osseus). This species, which accounted for 20 percent of the total from the reservoir, was found only at stations B1 and B2, and account for 39 percent of the fish collected from that station.

The red shiner was the most common species found in the Leon River, accounting for 50 percent of the individuals collected from Stations R and S. Station R was not seined due to the rate of flow and depth, so fish were collected with a dip net at this location.

The collection at Cowhouse Creek was dominated by the red shiners, which accounted for 74 percent of the total individuals collected. Fish were not collected from lower Cowhouse Creek (Station T) due to high water. Red shiners also dominated at Stations Y (Henson Creek), A (lower Clear Creek), I (upper House Creek), J (lower House Creek), and P (Turnover Creek), making up 86 percent of the individuals collected at these stations.

The Nolan Creek stations (N1 and N2) were dominated by the mosquitofish, which made up 84 percent of the populations. Bluegills were the only fish found at upper Clear Creek (Station F) and at Owl Creek (Station Z). However, only three individuals were found at these stations. The long-ear sunfish (Lepomis megalotis) was the most common fish found at lower Turkey Run (Station H), accounting for 65 percent of that population.

Members of the families Poeciliidae (livebearers), Cyprinidae (minnows), and Centrarchidae (sunfishes) were the most commonly collected. This is consistent with the literature and was expected, since these families contain large numbers of species, many of which occur in central Texas. Based on frequency of occurrence (i.e., number of stations at which a species was collected), the bluegill was the most cosmopolitan in the fall, followed by the mosquitofish and the red shiner. The bluegill was collected at 12 stations, the mosquitofish at 12, and the red shiner at eight during the fall survey. In spring, the most cosmopolitan was still the bluegill (14 stations),

followed by another member of the Centarchidae family -- the long-eared sunfish (nine stations) -- and two members of the Cyprinidae family -- the red shiner and black tail shiner (Notrodis venustus) -- both found at seven stations. The mosquitofish, a member of the Poeciilidae family, was found at seven stations. This was expected, since these species are widely distributed, have a tendency to form large populations, and are easily collected by seining.

The largest number of species collected in the fall was at lower Cowhouse Creek (Station T), mid Table Rock Creek (Station O), and lower Clear Creek (Station A). Eleven species were collected at each of these stations. Belton Lake Station B1 represented the lowest number of species, having a total of three. An average of six species was collected at the remaining 10 stations, with the species collected ranging from five to eight. It is not surprising that more species and larger numbers of individuals were collected at lower Cowhouse Creek, mid Table Rock Creek, and lower Clear Creek, since these streams had large pooled-up areas where the fish were concentrated. In addition, these areas were easily seined. The species collected in these pooled areas represent inhabitants of a variety of habitat types (e.g., riffles, vegetated areas, protected undercut banks, shallow flats) which are forced to cohabit pooled refugia during stressful (e.g., drought) conditions.

The largest number of species collected in the spring was from Belton Reservoir (Station B3), where 10 taxa were collected. The lowest number of taxa collected was from Stations R, F, and Z (upper Leon River, upper Clear Creek, and Owl Creek). The other 12 stations averaged approximately seven taxa. This lower number of taxa is expected under the spring survey conditions.

Overall, data presented in Tables 47 and 48 show that the number of individuals was generally much lower in the spring than in the fall except at Reese Creek (Statior D) and Belton Lake (Station 1). The number of each species collected from each station was also lower in spring except at Belton Lake and lower House Creek (Station J). Overall, the red shiner (Notropis lutrensis) was the most abundant species collected from creek habitats in the spring, although several other species were also widespread. Of the 28 taxa identified from spring collections, all but four were collected in the fall survey, when the total number of taxa was 26.

Important Species

Chapter 2 defines "Important Species."

Recreationally or Commercially Important Species

There is no commercial fishery at Belton Reservoir at this time, and the Texas Parks and Wildlife Department does not foresee the establishment of one. Species which could possibly form the basis for a commercial fishery at Belton Lake are carp (Cyprinus carpio), buffalo (Ictiobus bubalus) and gar (Lepisosteus oculatus and L. osseus).

Valuable recreational species at Belton Lake include largemouth bass (Micropterus salmoides), spotted bass (Micropterus punctulatus), white bass

(Morone chrysops), white crappie (Pomoxis annularis), flathead catfish (Pylodictis olivaris), and channel catfish (Ictalurus punctatus). Smallmouth bass (Micropterus dolomieui) and hybrid stripers (Morone chrysops x Morone saxatilis) were stocked in the lake in 1978.[73]

There are approximately 20 lakes, ranging in size from 3 to 25 surface acres, and an additional 130 to 135 smaller ponds within Fort Hood's boundaries. These waters are periodically stocked with channel catfish (I. punctatus) and largemouth bass (M. salmoides), depending on building and restoration activities associated with the impoundments. An average of three impoundments per year are stocked.[74]

Threatened and Endangered Species

The U.S. Department of the Interior's 1976 list of threatened and endangered fish species contains no species known to inhabit the project area. In addition, no freshwater mussels, snails, or crustaceans found within the study area are listed as threatened or endangered.

Hubbs[75] lists as problematical five species that could occur at Fort Hood: the suckermouth minnow (Phenacobius mirabilis), the gray redhorse (Moxostoma congestum), the big scale logperch (Percina macrolepida), the blue sucker (Cycleptus elongatus), and the Guadalupe bass (Micropterus treculi). The suckermouth minnow, gray redhorse, and big scale logperch are listed as "limited" (i.e., "species with reasonably broad distribution but limited to few areas [habitats] therein"). The blue sucker and Guadalupe bass are listed as "depleted" (i.e., "species whose abundance has declined substantially"). None of these species were collected during the surveys.

Other Important Species

Although no single species is considered critical to the well-being of the recreationally or commercially valuable species discussed above, forage fishes, as a group, are extremely important as food to the larger predatory game fishes. Based on survey results, the most important forage species onsite appear to be minnows, shad, and mosquitofish. Smaller species (most sunfishes) feed largely on aquatic invertebrates.

The most important species for maintaining the structure and function of Fort Hood's aquatic systems are those capable of converting terrestrial organic matter into animal biomass (detrital-based food chains). These species include most of the Crustacea and Oligochaeta and several orders of insect species. In many of the stream areas examined, considerable organic matter appears to be produced in situ by filamentous algae (Chlorophyta). The organisms responsible for converting this type of material to animal biomass (primary consumers) are often the same as, or closely related to, species

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73 B. Bounds, Texas Parks and Wildlife Department, Austin, personal communication (1978).

74 Fort Hood Fish and Wildlife Section, Fort Hood, Texas, personal communication (1978).

75 Clark Hubbs, A Checklist of Texas Freshwater Fishes, Tech. Ser. No. 11 (Tex. Parks and Wildlife Dept., 1976).

which feed on detritus. Most of these species are generalized feeders and, as such, one species assemblage may be replaced by another without apparent disruption of energy flow to higher trophic levels.

Significance of Local Aquatic Biology

Belton Lake is a multi-purpose reservoir that supplies potable water for domestic and industrial use. In addition, it is a recreational facility providing an area for sport fishing, boating, and water sports. The lake water chemistry and physical parameters is similar to those of other impoundments in the same drainage basin.

The numerous lakes and ponds at Fort Hood provide sport fishing. In addition, the various streams which form the drainage system for Fort Hood and the surrounding area provide an area for sport fishing, as well as contribute to the landscape's general aesthetic value.

The aquatic fauna and flora of Fort Hood's drainage system are similar in many respects to those of other areas in the south central United States. This diverse assemblage of micro- and macroscopic plants and animals interacts together and with the abiotic environment to produce a structured aquatic ecosystem. Because of the redundancy in organismic niches and the diversity of pathways for energy flow within the structure, this aquatic ecosystem can continue to exist under the changing conditions caused by natural seasonal variation in climate and/or manmade environmental alterations.

Table 22

Physical and Chemical Characteristics--Fall

Station*	Water Body	Date	Time	Depth (m)	Temperature (C)	Dissolved Oxygen (mg/L)	Conductivity (μmhos/cm^2)	pH	Secchi Depth (cm)
B1	Belton Lake	23 Aug 78	1745	0.50	32.3	8.0	430	8.6	23
B2	Belton Lake	23 Aug 78	1815	Surface	32.0	8.0	435	8.1	64
				1.0	32.0	7.8	435	-	-
				2.0	31.8	7.4	445	-	-
				3.0	31.5	7.4	450	-	-
				4.0	31.5	6.2	455	-	-
				8.0	-	-	-	-	-
B3	Belton Lake	24 Aug 78	1530	Surface	33.0	8.0	460	7.1	61
				1.0	33.0	6.4	485	-	-
B4	Belton Lake	24 Aug 78	1815	Surface	32.0	7.8	440	-	164
				7.5	31.0	7.8	455	-	-
				14.5	30.0	7.1	448	-	-
R	Upper Leon River	25 Aug 78	1700	Surface	31.0	7.1	1020	-	35
S	Lower Leon River	22 Aug 78	1830	Surface	28.0	>15.0	780	-	Bottom
K	Upper Cowhouse Creek	21 Aug 78	1510	Surface	29.8	7.8	550	7.7	30
L	Mid Cowhouse Creek (Pool 1)	21 Aug 78	1635	Surface	34.0	6.9	550	7.7	Bottom
L	Mid Cowhouse Creek (Pool 2)	21 Aug 78	1635	Surface	34.0	>15.0	-	-	-
T	Lower Cowhouse Creek	22 Aug 78	1105	Surface	25.5	5.0	780	-	30
O	Mid Table Rock Creek	21 Aug 78	1745	Surface	32.0	7.1	550	-	6
N1	Lower North Nolan Creek	25 Aug 78	1240	Surface	30.5	4.9	650	-	30
N2	Upper North Nolan Creek	24 Aug 78	1415	Surface	28.0	2.8	480	-	37
F	Upper Clear Creek	24 Aug 78	1030	Surface	25.5	1.6	315	7.0	30
A	Lower Clear Creek	22 Aug 78	1235	Surface	28.0	7.3	400	7.7	20
D	Lower Reese Creek	23 Aug 78	0830	Surface	25.2	2.0	190	7.3	5
H	Lower Turkey Run Creek	22 Aug 78	1105	Surface	25.5	5.0	780	-	30
I	Upper House Creek	22 Aug 78	0900	Surface	26.0	2.9	780	7.2	Bottom
J	Lower House Creek	22 Aug 78	1235	Surface	29.5	3.9	590	7.1	35

*For an explanation of terminology in table headings, see the appendix.

Table 23

Physical and Chemical Characteristics--Fort Hood--Spring

Station*	Water Body	Coordinates	Date	Time	Depth	Temp (C)	DO Mg/L	COND µmHOS/cm^2	pH	SeccHi Depth
B1	Belton Lake	329509	9 May	1530	Surface	22.2	9.2	382	8.4	134
B2	Belton Lake	344505	9 May	1330	Surface	22.3	8.9	381	8.3	61
B3	Belton Lake	409494	10 May	1440	Surface	27.2	8.4	457	6.5	78
B4	Belton Lake	415491	10 May	1505	Surface	25.6	10.8	408	8.0	108
R	Upper Leon River	215725	8 May	1805		21.2	10.7	375	8.0	
S	Lower Leon River	291676	8 May	1530		21.1	10.4	344	8.0	
K	Upper Cowhouse Creek	067618	9 May	0940		23.1	8.2	514	7.0	
K				2345		24.9	7.6	412	6.1	
L	Mid-Cowhouse Creek	148539	8 May	1030		22.7	11.7	476	8.1	
T	Lower Cowhouse Creek	299566	10 May	1815		29.2	18.0	482	8.2	
T				2445		26.8	7.1	476	7.9	
O	Mid Table Rock Creek	075572	8 May	0830		22.2	9.4	476	7.4	
N1	Lower Nolan Creek	389439	10 May	1650		26.0	9.1	440	7.9	
N2	Upper Nolan Creek	375445	9 May	1825		23.2	8.1	370	8.2	
F	Upper Clear Creek	115406	7 May	1640		25.1	8.7	572	8.1	
A	Lower Clear Creek	129449	7 May	1235		23.9	9.9	477	7.2	
A	Lower Clear Creek Inflow					23.5	9.9	488	8.0	
D	Lower Reese Creek	160325	7 May	1720		27.3	7.5	493	8.1	

*For an explanation of terminology in table headings, see the appendix.

Table 23 (Cont'd)

Station	Water Body	Coordinates	Date	Time	Depth	Temp (C)	DO Mg/L	COND µmHOS/cm^2	pH	SeccHi Depth
H	Lower Turkey Run Creek	085479	7 May	1330		23.0	9.8	658	8.3	
H	Lower Turkey Run Pool			1330		22.5	9.3	661	8.4	
I	Upper House Creek	069488	7 May	1440		25.3	7.5	631	8.2	
J	Lower House Creek	135505	7 May	1535		26.0	10.3	573	8.4	
P	Turnover Creek	175695	8 May	1700		25.5	10.3	405	8.0	
Y	Hensen Creek	253663	8 May	1855		24.4	10.8	476	7.9	
Z	Owl Creek	310572	8 May	1425		25.8	11.3	474	8.1	

Table 24

Habitat Characteristics--Fall

Station*	Dimensions (m)	Depth (m)	Substrate	Detritus	Algae/ Macrophytes	Canopy	Banks
B_1 Belton Reservoir		1.0	Very soft clay muck			Open water	
B_2 Belton Reservoir		4.0-8.0	Soft muck			Open water	
B_3 Belton Reservoir		1.0-1.5	Soft mud and detritus over rock	Leafy	Aphanothece masses	Open water	
B_4 Belton Reservoir		5.0	Fine gravel			Open water	
R Upper Leon River	10x100	0.5-1.2	Firm coarse sand, gravel	Woody, leafy	Najas, Lemna, algal mats	Partly open	Steep clay
S Loer Leon River	3-5x8-10	1.0-1.5	Cobbles, muck detritus	Leafy	Najas, Lemna, Chara, algal mats	Partly open	Steep clay
K Upper Cowhouse Creek	15x100	1.0-1.3	Gravel, rock near shore; muck, H_2S mud, detritus in channel	Leafy	Algal mats	Open; West bank shaded	Steep clay with roots on west; east bank gravel, rock, steep dirt
L Mid Cowhouse Creek		0.3	Rock with silt in holes		Chara	Open	Steep dirt
T Lower Cowhouse Creek	20x100	1.0-2.0	Soft mud, silt, detritus over rock	Leafy	Chara, green algal mats	Open	Unvegetated dirt
O Mid Table Rock Creek	5x75	0.4	Mud, silt over rock			Open; shaded North bank	Steep cut
N1 Lower North Nolan Creek	3x30	0.5	Very soft muck, detritus	Woody and leafy		Closed	Mud
N2 Upper North Nolan Creek	4x40	0.4	Firm fine gravel, mud, detritus over rock	Leafy	Bacopa, Myriophyllum	Partly open	Steep clay with roots
F Upper Clear Creek	5x50	1.0	Rock, detritus, some H_2S mud	Leafy	Chara	Partly open to closed	Undercut dirt with roots

*For an explanation of terminology in table headings, see the appendix.

Table 24 (Cont'd)

Station*		Dimensions (m)	Depth (m)	Substrate	Detritus	Algae/ Macrophytes	Canopy	Banks
A	Lower Clear Creek[a]	5x30	0.4-0.6	Soft muck in pool; rock riffle		Lemna, Bacopa, Sagittaria, blue-green algal mats	Open, shaded banks	Rock, steep clay
D	Lower Reese Creek	6x30	1.2	Boulders, muck, detritus	Leafy		Closed	Rock, mud
H	Lower Turkey Run Creek[a]	4x20 pool 2x30 riffle	0.4-0.7	Sand, rock in pool; rock and boulder riffle			Closed over pool; riffle unshaded	Steep clay
I	Upper House Creek[a]	4x50	0.4	Silt, gravel over rock slab in pool; boulder riffle		Hydrodictyon mats, Bacopa	Partly open over pool; closed over riffle	Cut dirt, rock
J	Lower House Creek[b]	10x75	1.0	Silt over rock	Woody, leafy	Some emergents	Partly open, well-shaded banks	Cut dirt (clay) with roots

Comments:
[a]Flowing at time of sampling
[b]Dam below pool

Table 25

Habitat Characteristics--Spring Survey

Station*	Water Body	Dimensions	Depth	Substrate	Detritus	Algae/Macrophtes	Canopy	Banks
B1	Belton Reservoir		1.0	Very soft clay muck			Open Water	
B2	Relton Reservoir		8	Soft mud			Open Water	
B3	Belton Reservoir		1	Inundated mud flat			Open Water	
B4	Belton Reservoir		14	Fine gravel			Open Water	
R	Upper Leon River		.2-.3m over bridge				Closed	Steep Clay
S	Lower Leon River			Gravel/sand rocks				Partly Open
K	Upper Cowhouse Creek	10x100	.6m	Gravel	Leafy		Open	Steep Clay
L	Mid Cowhouse Creek		.6m	Rock, gravel			Open	Steep Dirt
T	Lower Cowhouse Creek	3x5	1-2m over bridge	Silt on low water bridge			Open	Steep Dirt
O	Mid Table Rock Creek		7/m	Soft muck, H_2S mud	Woody	Chara, Najas, Zannichellia Palustris	Open	Steep Cut
N1	Lower Nolan Creek	3x30	.6m	Soft muck, detritus	Woody and Leafy	Chara, Samolus Parviflorus	Closed	Mud
N2	Upper Nolan Creek	2x40	.4m	Soft muck, gravel	Leafy	Myriophyhum Bacopa Potamogeton	Open,Shaded North	Steep Clay with roots
F	Upper Clear Creek	12x50	1.3	Rock, mud	Leafy	Chara	Partly Open	Undercut dirt with roots
A	Lower Clear Creek	5x30	.6	Mud, gravel detritus	Leafy	Sagittaria Platyphylla Zannichella Palustris Lemna	Open, Shaded Banks	Rock, Steep clay

*For an explanation of terminology in table headings, see the appendix.

Table 25 (Cont'd)

Station	Water Body	Dimensions	Depth	Substrate	Detritus	Algae/Macrophtes	Canopy	Banks
D	Lower Reese Creek	6x30	.3-1.1	Rocks, H_2S Mud, Detritus	Leafy	Chara	Partly Closed	Rock, mud
H	Lower Turkey Run Creek	3x50	.4m	Rocks, sand	Leafy	Veronica	Closed	Steep Clay
I	Upper House Creek	3x50	.5m	Gravel/sand in pool Rocks in riffles	Leafy		Partially Open	Cut Dirt Rock
J	Lower House Creek	12x75	1.5	Mud	Leafy		Open	Undercut Clay
P	Turnover Creek	3x40	.3	Gravel Sand			Open	Steep Clay
Y	Henson Creek	3x50	.4	Slabe/Gravel/ Silt Layer	Leafy		Open	Steep Clay
Z	Owl Creek	6x30	.5	Rock Gravel		Chara	Open	Steep Clay

Table 26

Phytoplankton--Organisms/ml--Fort Hood--Fall

Taxa*	Station:																
	B1	B2	B3	B4	R	S	K	T	O	N1	N2	F	A	D	H	I	J
CHLOROPHYTA																	
Actinastrum hantzschii						68		34					238				527
Ankintrodesmus falcatus				17	17		323	85	680	1768		17	17				170
Carteria sp.					170			4675									17
Cerasterias sp.				17													
Characium limneticum		34		17			34	884	51	17			34				391
Characium sp.		17	60		68	34	170	34	442		20	17	289		272		
Chlamydomonas sp.	119							17	17				527		901	170	187
Chlorococcum sp.	34	17						153							34		
Chloroqonium elongatum						17			34						17		
Closterium sp.			9				136	34	306								
Coelastrum sp.	136	68	60	85	136	17	136	255	2601	17	48	136			221		
Cosmarium sp.								425	714			17			68		17
Crucigenia rectangularis			17	34	51		51	272									
Crucigenia tetrapedia		136			136		425		68								
Dictyosphaerium sp.				68					34						697		
Elakatothrix sp.						17									187		
Furcilia sp.						17	17		170								
Gloeocystis sp.	34	17	17	51		17	34	34		34							
Golenkinia sp.	17	34	17		136	51	442	204	238	102		85			119		
Kirchneriella sp.							34			68					17		85
Micractinium sp.	17			374			17	136	7242						221		272
Oocystis sp.	51	17			102	85			17						221		17
Pandorina morum							17	17	85				17		187		17
Pediastrum duplex	51	102	26	17			1241										
Pediastrum simplex					527				187								
Protoderma sp.			51						136				68				
Scenedesmus armatus var. bicaudatus																	
Scenedesmus denticulatus							34										

*For an explanation of terminology in table headings, see the appendix.

Table 26 (Cont'd)

Taxa	Station: B1	B2	B3	B4	R	S	K	T	O	N1	N2	F	A	D	H	I	J
CHLOROPHYTA (cont'd)																	
Scenedesmus dimorphus	68						1020	68	442								
Scenedesmus quadricauda		102	68		238	68	1224	306	2822	850			680		238		2686
Scenedesmus sp.			34	136	255		17	68				68	153		136		204
Schroederia setigera	68				17		153		17				68		629		34
Selenastrum westii	34								68				17				
Spermatozoopsis exultans						68		53	34				34				
Sphaerocystis sp.		34	9	68	17		85	221	102						187		
Staurastrum sp.		17					17										
Stichococcus bacillaris												17	17				
Tetraedron gracile										17							
Tetraedron regulare					17			68		85	14	51					17
Tetrastrum sp.								17	391								
Miscellaneous green algae	935	2023	1182	2159	850	1496	3332	1530		187	565	6188	51		3179	561	1037
EUGLENOPHYTA																	
Cryptoglena pigra								102					136				
Euglena acus		17				255	765	238		238	143	1207	374	578			
Euglena spirogyra												17					
Euglena sp.	170	136	111	17	1360	1853	102	68	136	510	129	238	20094		136	51	1343
Euglenophyceae		17			51	102	153	17			170	17	17	5049			
Lepocinclis ovum		34									20	68	17	119			
Phacus longicauda		34							17		41	85	68	17			
Phacus tortus	51	34			34	17	17	17		323		85	51	51	17		
Phacus sp.	170	85	17	17	85	918	68		17	68		187	17				17
Trachelomonas volvocina	102	102	68		1003	697		85	1530	408	163	153	85	612			68
Trachelomonas sp.								17	1598	1666	75						

Table 26 (Cont'd)

Taxa	Station: B1	B2	B3	B4	R	S	K	T	O	N1	N2	F	A	D	H	I	J
CHRYSOPHYTA																	
Centritractus sp.					17	68.											
Dinobryon sp.		17		17		119	442						68				
Mallomonas sp.	34	34			85	136	170	68	153	1054	122	153		85	34		41
BACILLARIOPHYTA																	
Cyclotella meneghiniana	170	51	51	34	68		289	391	187	119		68	204		187	6511	1581
Diploneis sp.																	17
Gomphonema parvulum																	
Mastogloia sp.			9												34	17	
Melosira granulata			17		17		306	34									
Melosira granulata var. angustissima							170										
Navicula pupula			9														
Navicula radiosa									34				34				
Navicula rhynchocephala											14						
Navicula sp.	51	85	34		17	85			102	17		17	17			17	
Nitzschia acicularis				187	34			85		374		102			68	68	34
Nitzschia closterium						17			17								
Nitzschia linearis	17																
Nitzschia palea	119	17	34		85		102	102	272	187	48	289	68	408	476	425	391
Nitzschia sp.									102						68	119	
Pinnularia sp.								17									
Pleurosigma sp.			9			17											
Synedra delicatissima	1530	1156	442				51										
Synedra ulna	68	51	51	102		17	136										34

Table 26 (Cont'd)

Taxa	Station: B1	B2	B3	B4	R	S	K	T	O	N1	N2	F	A	D	H	I	J
PYRROPHYTA																	
Ceratium hirundinella			9								14						
Clenodinium sp.			9		17	204	17			34		255					17
Peridinium sp.	17	102	26	51	357	697				34				17			
CYANOPHYTA																	
Anabaena sp.	17	17				51											17
Aphanocapsa sp.	17				17												
Chroococcus sp.	68	170	34	68	221	204	306	561	901		54	255					17
Coelosphaerium sp.				34				170									
Holopedium sp.	816	510	170	1904			323	306	51			17			187	102	
Merismopedia sp.	68	153	51	544	238	34	1037	221	34			187				102	
Microcystis sp.			34										17				
Oscillatoria sp.	1105	663	264	425	85	102	986	476				34	51		51	136	102
Schizothrix sp.	1411	1326	561	629							41						
Spirulina sp.																	
CRYPTOPHYTA																	
Cryptomonas sp.	680	680	366	204	1020	867	697	51	714	612	381	1037	119	374	85		1037
Total (No. Taxa)	32	36	34	26	34	32	41	42	40	24	18	29	31	10	29	12	30
Total (No./ml)	8245	8109	3926	7276	7548	8415	15096	12614	22763	8789	2062	11067	23647	7310	8874	8279	10472

Table 27

Phytoplankton Densities--Organisms/ml--Fort Hood--Spring

Taxa* Stations:	B1	B2	B3	B4	R	S	K	T	O	N1	N2	F	A	D	11	I	J
Chlorophyta																	
Actinastrum hantzschii								17.0									
Ankistrodesmus sp.	51.0	8.5	42.5				13.6	255.1			3.4		3.4		6.8	8.5	
Carteria sp.		47.6	28.4	6.8						13.6							
Characium limneticum								34.0		10.2	12.4			1.7	10.2		
Characium sp.			5.6				25.0	187.0	14.2			2.2		6.8		119.0	3.4
Chlamydomonas sp.		39.1	144.6				518.1	45850.3	26.0	54.4	12.4	23.1	152.5	8.5	120.8	184.2	82.8
Chlorella sp.							34.0		20.4			1.0		8.5	141.2	34.0	8.0
Closterium sp.			25.5	31.8				17.0	1.7	51.0	63.5	3.6	3.4			53.8	
Coelastrum sp.		20.4	25.5	6.8				34.0									
Cosmarium sp			17.0					51.0	7.4	20.4	3.4		2.3			11.4	
Crucigenia tetrapedia	11.4	8.5	17.0	13.6							2.2						
Elakatothrix sp.										6.8	6.8						
Gloeocystis sp.	136.1	34.0	79.4							105.4	79.4						
Golenkinia sp.				11.4				51.0									
Kirchneriella sp.							26.0	136.0									
Micractinium sp.													6.8				
Oocystis sp.	45.4	85.0	5.6	102.5			27.2			40.8	3.4						
Pediastrum boryanum			5.6														
Protococcus sp.				215.4			11.4										
Protoderma sp.			45.4														
Scenedesmus armatus	158.8		51.0	45.4				68.0									
Scenedesmus dimorphus							54.4	34.0		13.6	13.6						
Scenedesmus quadricauda		61.2	79.4	68.0			224.4	935.4									
Scenedesmus sp.			22.7							27.2	45.4		5.1			102.0	
Schroederia setigera			79.4				47.6	510.2		37.4	45.4				3.4	73.7	
Selenastrum sp.		17.0															
Sphaerocystis sp.	272.1	159.8	51.0	206.4			107.7		1.7	10.2	31.8				10.2		6.8
Stauroneis sp.							5.6										

*For an explanation of terminology in table headings, see the appendix.

Table 27 (Cont'd)

Taxa	Stations:	L	P	Y	Z
Chlorophyta					
Actinastrum hantzschii		18.2			
Ankistrodesmus sp.		61.2			
Carteria sp.					
Characium limneticum					
Characium sp.		6.8	24.0		
Chlamydomonas sp.		86.2		9.8	30.6
Chlorella sp.					
Closterium sp.					
Coelastrum sp.					
Cosmarium sp.		3.4			
Crucigenia tetrapedia					
Elakatothrix sp.					
Gloeocystis sp.					
Golenkinia sp.					
Kirchneriella sp.		5.6			
Micractinium sp.					
Oocystis sp.		44.2			20.4
Pediastrum boryanum					
Protococcus sp.					
Protoderma sp.					
Scenedesmus armatus					
Scenedesmus dimorphus		13.6			
Scenedesmus quadricauda		208.6			
Scenedesmus sp.					
Schroederia setigera		42.0			
Selenastrum sp.					
Sphaerocystis sp.		9.0			
Stauroneis sp.					

Table 27 (Cont'd)

Taxa Stations:	B1	B2	B3	B4	R	S	K	T	O	N1	N2	F	A	D	11	I	J
Chlorophyta (cont'd)																	
Tetraedron minimum			11.3							3.4	3.4						
Tetrastrum staurogeneiforma								17.0									
Tetrastrum sp.								34.0									
Euglenophyta																	
Euglena acus			8.5										11.4		3.4	11.4	
Euglena spirogyra										3.4							
Euglena sp.			5.6				11.4	493.2		10.2	22.6		12.4	1.7	3.4	22.7	6.2
Lepocinclis ovum								17.0									
Phacus pyrum										6.8					6.8		
Phacus sp.								51.0		3.4	6.8	0.8	39.1	1.7		8.5	
Trachelomonas sp.								17.0			2.2		1.7				
Chrysophyta																	
Chrysamoeba sp.															1.7		1.7
Dinobryon sp.				408.2						10.2	8.0						
Mallomonas sp.		6.8	19.8	11.4			11.4	170.0		6.8	6.8		2.3		1.7		
Bacillariophyta																	
Achnanthes linearis			56.6				32.8										
Achnanthes microcephala									360.0	20.4	4.5	60.7	47.0	149.7	16.9	19.8	38.0
Amphora ovalis												1.0				34.0	2.2
Amphora sp.			5.6														
Caloneis sp.		6.8							2.2					1.7		8.5	
Cocconeis placentula																11.4	
Cocconeis pediculus										3.4		69.4	125.8			8.5	9.0
Cyclotella meneghiniana	90.7	93.5	249.4				259.6	952.4		204.1	96.4	3.0	52.7		416.6	8.5	145.1
Cymbella cymbiformis																11.4	
Cymbella microcephala									45.4		6.8	1.0		35.7			4.6

Table 27 (Cont'd)

Taxa Stations:	L	P	Y	Z
Chlorophyta (cont'd)				
Tetraedron minimum				
Tetrastrum staurogeneiforma				
Tetrastrum sp.				
Euglenophyta				
Euglena acus				
Euglena spirogyra				
Euglena sp.	15.8			1.7
Lepocinclis ovum				
Phacus pyrum				
Phacus sp.				
Trachelomonas sp.				
Chrysophyta				
Chrysamoeba sp.				
Dinobryon sp.				
Mallomonas sp.	5.6			
Bacillariophyta				
Achnanthes linearis				
Achnanthes microcephala	30.6	26.6	83.4	272.1
Amphipleura pellucida			3.6	5.1
Amphora sp.		2.8		
Caloneis lewisii		2.6		1.7
Cocconeis placentula	47.6	53.3	31.0	
Cocconeis pediculus				
Cyclotella meneghiniana	97.5	26.6	10.0	
Cymbella cymbiformis				
Cymbella microcephala	3.4		10.4	

Table 27 (Cont'd)

Taxa Stations:	B1	B2	B3	B4	R	S	K	T	O	N1	N2	F	A	D	11	I	J
Bacillariophyta (cont'd)																	
Cymbella minuta									38.6	10.2		39.6	54.4	90.1		144.6	38.6
Cymbella sp.			59.5				71.4					1.0	4.5	3.4			
Diploneis sp.									4.6		4.6			20.4			4.0
Eunotia sp.				1167.8								4.2		1.7		11.4	
Fragilaria sp.												3.0		35.7			
Gomphonema parvulum							6.8		1.7			6.6	4.6				4.6
Gomphonema sp.													5.1	11.9	3.4	42.5	
Gyrosigma scalproides														1.7			
Hantzschia amphioxys																11.4	
Melosira granulata																	
Melosira sp.											267.6						
Meridion circulare												0.8					
Navicula capitata													5.6				
Navicula lanceolata								51.0								226.8	
Navicula pupula									4.6						1.7	25.5	1.7
Navicula radiosa							6.8		6.8			4.2	2.2	5.1	5.1		6.2
Navicula sp.			62.4				30.6	17.0	66.9	57.8	6.8	26.6	113.9	98.6	64.6	462.0	87.3
Navicula viridula var. linearis										3.4			3.4				
Neidium sp.													1.7				
Nitzschia acicularis	5.6	13.6	53.8				71.4	170.1	1.7	13.6	3.4	3.4	4.0		6.8		14.8
Nitzschia filiformis							5.7										
Nitzschia linearis									1.7				4.0	5.1	3.4	110.6	2.2
Nitzschia palea			119.1	20.4			233.6	374.2	148.0	108.8	45.4	50.6	158.2	51.0	210.8	1731.8	349.8
Nitzschia recta									4.6					11.9			4.0
Nitzschia sigma												1.0					
Nitzschia sigmoidea													2.3				4.6
Nitzschia tryblionella													1.7				4.6
Nitzschia tryblionella var. levidensis																	
Nitzschia sp.									14.8				7.4	16.9	23.8	11.4 113.4	6.8 1.7

Table 27 (Cont'd)

Taxa Stations:	L	P	Y	Z
Bacillariophyta (cont'd)				
Cymbella minuta	17.0	79.4	46.5	54.4
Cymbella tumida	56.7			
Dentienia elegans				32.3
Diploneis sp.				
Eunotia sp.				
Fragillaria sp.				
Gomphonema parvulum	8.0			76.5
Gomphonema sp.				
Gyrosigma sp.	6.8			
Hantzschia amphioxys				
Melosira granulata				
Melosira sp.				
Meridion circulare				
Navicula cryptocephala		0.8		1.7
Navicula heufleri	20.4			
Navicula lanceolata				3.4
Navicula pupula	6.8	3.8		
Navicula radiosa				
Navicula sp.	76.0	19.8		5.1
Navicula viridula var. linearis				
Neidium sp.				
Nitzschia acicularis	53.3	36.4	29.8	100.3
Nitzschia denticulata	9.0			
Nitzschia linearis				15.3
Nitzschia palea	277.8	126.6	41.6	30.6
Nitzschia recta				
Nitzschia sigma				
Nitzschia sigmoidea				
Nitzschia tryblionella				
Nitzschia tryblionella var. levidensis	2.2			
Nitzschia sp.	11.4		1.4	

Table 27 (Cont'd)

Taxa Stations:	B1	B2	B3	B4	R	S	K	T	O	N1	N2	F	A	D	11	I	J
Bacillariophyta (cont'd)																	
Surirella ovalis							5.6									8.5	6.8
Surirella ovata															6.8	22.7	2.7
Synedra tenera			17.0					17.0								22.7	
Synedra ulna			8.5						2.2	10.2	3.4	33.2	6.8	1.7			9.6
Synedra sp.	22.7						26.0			6.8	5.6	4.4		18.7	1.7		
Pyrrophyta																	
Ceratium hirundinella	5.6	30.6	17.0	11.4						3.4							
Glenodinium sp.	34.0		5.6					17.0									
Peridinium sp.			8.5					17.0				0.8					
Cyanophyta																	
Anabaena sp.											2.2						
Aphanothece sp.							27.2							45.9		22.7	
Chroococcus sp.			59.5	74.8				578.2	13.6	163.2	54.4			51.0		153.0	
Merismopedia sp.											197.3						
Microcystis sp.	17.0	20.4															
Oscillatoria sp.																22.7	
Schizothrix sp.	11.4	8.5					18.2		13.6	17.0	2.2	7.4		15.3	5.1	141.7	
Cryptophyta																	
Chroomonas sp.	1275.5	816.4	586.8	1035.5			521.6	4013.6	6.8	78.2	26.1	1.7	7.4	8.5		73.7	
Cryptomonas sp.	1315.2	956.6	887.2	637.2			87.3	7874.2	18.2	364.0	256.2	6.7	28.4		28.9	189.9	1.7
Total (No. taxa)	15	19	36	18	0	0	29	32	25	34	36	27	32	28	25	38	29
Total (No./ml)	3452.5	2434.3	2967.3	4074.8	0	0	2522.4	63060.9	827.4	1499.7	1355.8	361.0	881.5	710.6	1105.2	4280.3	859.5

Table 27 (Cont'd)

Taxa Stations:	L	P	Y	Z
Bacillariophyta (cont'd)				
Rhoicosphenia curvata	3.4			
Surirella ovalis				
Surirella ovata				
Synedra tenera	74.8		0.7	
Synedra ulna				49.3
Synedra sp.				
Pyrrophyta				
Ceratium hirundinella				
Glenodinium sp.				
Peridinium sp.				
Cyanophyta				
Anabaena sp.				
Aphanothece sp.			0.7	
Chroococcus sp.	22.7			
Merismopedia sp.				
Microcystis sp.				
Oscillatoria sp.				
Schizothrix sp.	32.8	17.5	10.2	30.6
Cryptophyta				
Chroomonas sp.	53.2		0.8	3.4
Cryptomonas sp.	35.2		3.6	
Total (No. taxa)	35	13	15	18
Total (No./ml)	1466.8	420.2	289.5	734.5

Table 28

Algae--Percent Composition--Fall--Fort Hood

Taxa*	Station:	K	T	O	F	A	I	J	H	N1	N2	R	S	D	B1	B2	B3	B3
Chlorophyta		59.3	76.1	74.3	59.5	9.2	8.9	54.9	84.8	35.7	31.5	36.2	23.7	0	19.0	32.3	39.5	41.9
Euglenophyta		8.3	4.3	14.5	18.6	88.2	0.6	13.6	1.7	36.6	35.9	33.6	45.7	87.9	6.0	5.7	5.0	0.5
Chrysophyta		4.1	0.5	0.7	1.4	0.3	0	0.5	0.4	12.0	5.9	1.4	3.8	1.2	0.4	0.6	0	0.2
Bacillariophyta		7.0	5.0	3.1	4.3	1.4	86.4	19.6	9.4	7.9	3.0	2.9	1.6	5.6	23.7	16.8	16.7	4.4
Pyrrophyta		0.1	0	0	2.3	0	0	0.2	0	0.8	0.7	5.0	10.7	0.2	0.2	1.3	1.1	0.7
Cyanophyta		17.6	13.7	4.3	4.6	0.4	4.1	1.3	2.7	0	4.6	7.4	4.2	0	42.5	35.0	28.4	49.5
Cryptophyta		4.6	0.4	3.1	9.3	0.5	0	9.9	1.0	7.0	18.4	13.5	10.3	5.1	8.2	8.3	9.3	2.8

*For an explanation of terminology in table headings, see the appendix.

Table 29

Algae--Percent Composition--Spring

TAXA*	STATION																			
	B1	B2	B3	B4	R	S	K	T	O	N1	N2	F	A	D	H	I	J	L	P	Y	Z
CHLOROPHYTA	19.5	14.8	24.8	17.4			43.4	76.5	8.6	26.3	24.1	8.3	19.7	3.6	26.5	13.7	11.7	34.	5.71	3.39	6.94
EUGLENOPHYTA			0.5				0.5	.92		1.6	2.3	0.2	7.3	0.5	1.2	1.3	0.7	1.08			.231
CRYSTOPHYTA		0.3	0.7	10.3			0.5	.27		1.1	1.1		0.3		0.3		0.2	.38			
BACILLARIOPHYTA	3.4	4.7	21.3	29.2			29.7	2.5	83.3	29.3	32.8	86.9	68.7	78.9	68.9	71.2	87.1	57.73	90.12	91.33	38.20
PYROPHYTA	1.1	1.3	1	0.3				.05		0.2		0.2									
CYANOPHYTA	0.8	1.2	2	1.8			1.8	.92	3.3	12	18.9			15.8	0.5	7.9		3.78	4.16	3.77	4.17
CRYPTOPHYTA	75	72.8	49.7	41.1			24.1	18.85	3	29.5	20.8	2.3	4.06	1.2	2.6	6.2	0.2	6.03		1.52	.46
Total # of Organisms/ml	3452.5	2434.3	2967.3	4074.8	--	--	2522.4	63060.9	827	1499.7	1356.8	361	881.5	710.6	1105.2	4280.3	859.5	1466.8	420.2	289.5	
Total # of Taxa	15	14	36	18	--	--	24	32	25	34	36	27	32	28	25	38	29	35	13	15	

*For an explanation of terminology in table headings, see the appendix.

Table 30

Chlorophyta and Euglenophyta--Dominant Form--
Fort Hood--Fall

Station*	Dominant Form	Subdominant Form
Upper Cowhouse Creek (K)	Miscellaneous[1]	Scenedesmus
Lower Cowhouse Creek (T)	Carteria	Miscellaneous
Table Rock Creek (C)	Oocystis	Scenedesmus
Upper Clear Creek (F)	Miscellaneous	Euglena
Lower Clear Creek (A)	Euglena	Scenedesmus
Upper House Creek (I)	Miscellaneous	Chlamydomonas
Lower House Creek (J)	Scenedesmus	Euglena
Turkey Run (H)	Miscellaneous	Schrederia
Upper N. Nolan Creek (N1)	Ankistrodesmus	Trachelomonas
Lower N. Nolan Creek (N2)	Lepocinclis	Trachelomonas
Upper Leon River (R)	Euglena	Trachelomonas
Lower Leon River (S)	Euglena	Miscellaneous
Reese Creek (D)	Euglenaphyceae	Euglena
Belton Lake (B1)	Miscellaneous	Trachelomonas and Euglena
Belton Lake (B2)	Miscellaneous	Euglena
Belton Lake (B3)	Miscellaneous	Euglena
Belton Lake (B4)	Miscellaneous	Oocystis

*For an explanation of terminology in table headings, see the appendix.

[1]Miscellaneous - unidentified green algae.

Table 31

Chlorophyta and Euglenophyta--Dominant Form--Fort Hood--Spring

Station*	Dominant Form	Subdominant Form
B1	Sphaerocystis sp.	Scenedesmus Armatus
B2	Sphaerocystig sp.	Oocystis sp.
B3	Chlamydomonas sp.	Glorocystis sp. Sceneoesmus Quadrkauna
B4	Sphacrocystis sp.	Protococcys sp.
K	Chlamydomonas sp.	Scenepesmus quaoricauoa
T	Chlamydomonas sp.	Scenepesmus quaoricauoa
0	Chlamydomonas sp.	Chlorella sp.
N1	Gloeocystis	Chlamydomonas sp.
N2	Gloeocystis	Closterium
F	Chlamydomonas sp.	Closterium
A	Chlamydomonas sp.	Phacus sp.
D	Chorella sp.	Characium sp.
H	Chorella sp.	Chlamydomonas sp.
I	Chlamydomonas sp.	Characium sp.
J	Chlamydomonas sp.	Chorella
L	Sceneorsmus quaoricauda	Chlamydomonas sp.
P	Charalium Limneticum	
Y	Chlamydomonas sp.	
Z	Chlamydomonas sp.	Oocystis sp.

*For an explanation of terminology in table headings, see the appendix.

Table 32

Cyanophyta--Dominant Forms--Belton Lake

Station	Dominant Form		Subdominant Form	
	Fall	Spring	Fall	Spring
Belton Lake 1	Spirulina	Microcysitis sp.	Schizothrix	Schizothrix
Belton Lake 2	Spirulina	Microcysitis sp.	Schizothrix	Schizothrix
Belton Lake 3	Spirulina	Chroocoeus sp.	Schizothrix	
Belton Lake 4	Spirulina	Chroococcus	Microcystis	

Table 33

Periphytic Diatoms--Relative Abundance (%)--Fort Hood-Fall

Taxa*	Station: R 1[a]	R 2[a]	S	K 1[a]	K 2[a]	L	T 1[a]	T 2[a]	O	N1	A	H	I	J
Melosira granulata				5.8			5.0	6.1	4.8				0.5	
Melosira granulata var. angustissima	6.1			11.6					3.8					
Melosira sp.					2.5									
Cyclotella atomus	0.5						5.0	0.9						
Cyclotella meneghiniana	0.9	3.2	0.4	3.4		1.0	5.0	26.8	14.3	0.5	15.7	23.8	5.7	3.7
Cyclotella pseudostelligera								2.8	4.8					
Cyclotella stelligera	0.5				1.0									
Stephanodiscus hantzschii								0.5						
Stephanodiscus invisitatus								1.4	2.9					
Stephanodiscus minutus								4.7	0.5					
Terpsinoe americana		0.3					6.1		2.9					
Thalassiosira fluviatilis											0.5			
Fragilaria leptostauron									0.5					
Fragilaria sp.			42.1											58.7
Fragilaria vaucherii		0.5												
Synedra acus				0.5										
Synedra ulna		3.7	1.7	0.5				2.3	1.4					
Achnanthes affinis									1.0					
Achnanthes exigua					2.0									
Achnanthes exigua var. constricta				0.5								1.9		0.5
Achnanthes lanceolata										0.5				
Achnanthes lapponica		0.9									0.5			
Achnanthes linearis		0.5			2.0		1.5				25.3	8.1	0.5	
Achnanthes microcephala					0.5					2.4				
Achnanthes sp.		1.4								0.3				
Cocconeis pediculus		0.5					0.8				0.5			
Navicula accomoda			0.4		0.5						0.5		0.5	

*For an explanation of terminology in table headings, see the appendix.

Table 33 (Cont'd)

Taxa	Station: R 1[a]	R 2[a]	S	K 1[a]	K 2[a]	L	T 1[a]	T 2[a]	O	N1	A	H	I	J
Navicula arvensis									0.5					
Navicula capitata	0.5				0.5									
Navicula cryptocephala var. veneta						0.5								
Navicula cuspidata		0.5		0.5		1.0				0.5				
Navicula grimmei					1.0									
Navicula halophila	0.5				1.5			2.8	1.4					
Navicula heufleri		0.5		0.5	1.0	1.0	0.8			0.5		0.9	21.0	
Navicula lanceolata	0.5			1.0	0.5					1.0	0.9	0.5		
Navicula mutica		0.5												
Navicula placentula var. rostrata	1.4						0.4			14		0.5		
Navicula pupula	2.8	0.5		1.5	3.0	4.9	0.4		2.4	2.8		0.5	0.5	
Navicula pupula var. mutata	0.5													
Navicula pygmaea				1.0		0.5			0.5	0.5	0.9		1.0	0.5
Navicula radiosa		13.0				0.5			0.5					
Navicula radiosa var. tenella	1.9	5.1				0.5	0.8			1.0			2.4	
Navicula rhynchocephala			0.4			2.0	0.4			0.5				
Navicula savannahiana				0.5							1.4			
Navicula sp.	2.3						0.5	0.5	5.7	2.3				
Navicula symmetrica	0.5										0.5		1.4	0.5
Navicula texana					0.5									
Navicula viridula													0.5	
Navicula viridula var. linearis	1.9													
Pinnularia biceps		0.5		1.9			0.4				0.5		0.5	
Pinnularia sp.						1.0								
Caloneis bacillum						2.5							1.4	
Caloneis oregonica									1.4					

Table 33 (Cont'd)

Taxa	Station: R 1[a]	R 2[a]	S	K 1[a]	K 2[a]	L	T 1[a]	T 2[a]	O	N1	A	H	I	J
Caloneis ventricosa						1.0								
Anomoeoneis sphaerophora	1.4						0.4							
Anomoeoneis vitrea		3.7		6.8	13.5					44.4				
Diploneis elliptica		1.4												
Diploneis smithii	0.9			3.4	1.5	1.5	1.1		0.5					
Stauroneis anceps		0.5		1.5		1.0				1.0			0.5	
Amphipleura pellucida		0.5												
Gyrosigma balticum		0.5												
Gyrosigma scalproides													2.4	
Gyrosigma sp.			0.4				0.8		0.5	0.5				
Pleurosigma sp.	0.5						0.4							
Mastogloia smithii		6.5		0.5					0.5					
Gomphonema brasiliense	13.6						10.0			0.5	12.4			
Gomphonema dichotomum		0.5	0.9	1.0						6.3				0.5
Gomphonema intricatum													2.4	
Gomphonema intricatum var. vibrio									0.5					
Gomphonema parvulum	0.5	3.2	1.3			7.9	6.9	8.9	1.4			7.1	11.0	3.7
Gomphonema subclavatum									2.4					
Cymbella laevis										3.9				
Cymbella microcephala				1.9	3.0					0.5				
Cymbella minuta		0.5			0.5	7.9	1.5	1.4		0.5	0.5			
Cymbella sinuata											2.3			
Cymbella tumida							1.1							
Amphora normanii							0.8				0.5	0.9	9.0	
Amphora ovalis	0.9	0.9					1.9		2.9					
Amphora veneta											0.5		1.0	
Epithemia argus var. protracta		0.5												
Epithemia turgida		7.4							3.8					
Rhopalodia gibba	0.9		45.1				1.5							
Rhopalodia gibberula		3.2					1.5							
Rhopalodia gibberula var. vanheurckii	6.1	0.9							1.4	0.5				

Table 33 (Cont'd)

Taxa	Station: R 1[a]	R 2[a]	S	K 1[a]	K 2[a]	L	T 1[a]	T 2[a]	O	N1	A	H	I	J
Hantzschia amphioxys														
Nitzschia acicularis		0.5		0.5		0.5	1.5		2.4				0.5	
Nitzschia amphibia	11.7	12.0	0.8	20.9	22.0	2.5	10.7	8.0	4.8	26.1	16.1	44.3	3.8	28.6
Nitzschia apiculata									1.9					
Nitzschia closterium			0.9					1.9	0.5					
Nitzschia denticula					0.5									
Nitzschia dissipata						2.0			0.5					
Nitzschia filiformis		2.3	0.9			14.8	5.4						0.5	
Nitzschia frustulum	14.1	0.5	0.4	2.4		19.7	0.4	1.4			2.8	1.9	3.8	
Nitzschia hungarica					2.0			0.5						
Nitzschia linearis	1.4		0.9	0.5	3.5		0.4	2.3	2.4		4.1			
Nitzschia recta													7.2	
Nitzschia palea	19.2	7.4	4.7	23.3	35.0	26.1	14.2	21.1	12.0	5.8	12.9	8.1	16.7	1.9
Nitzschia paradoxa	7.5	14.3		3.9			13.4	1.4	10.5				0.5	
Nitzschia sigma								1.4			0.5		1.0	
Nitzschia sp. 1				2.9				2.3	0.5				2.9	
Nitzschia sp. 9				1.0									0.9	0.9
Nitzschia trybionella var. levidensis	0.5	0.5									0.5	0.5		
Nitzschia tryblionella					1.5				1.0					
Cymatopleura elliptica		0.9												
Surirella ovata var. pinnata					0.5									
Surirella ovata				0.5				0.5				0.9	0.5	
Total No. Taxa	28	37	15	28	24	22	32	22	36	24	22	14	28	11

Comments: [a]Two substrates collected

Table 34

Periphyton Diatom Relative Abundances (%)--Fort Hood--Spring

Taxa* Stations:	S	L	T	O	N_1	N_2	A	I	J
Melosira granulara					2.9	1.9			
Melosira varians	4.0								
Cyclotella atomus					0.5				
Cyclotella meneghiniana	1.5		0.5		2.4	2.4	1.5		
Cyclotella stelligera					3.4	1.0			
Stephanodiscus invisitatus		1.0							
Meridion circulare									0.9
Synedra delicatissima		1.0				1.9			
Synedra rumpens						0.5			
Synedra ulna	17.4	2.9	1.9		4:9	9.5			0.4
Achnanthes lanceolata		2.0							
Achnanthes microcephala	10.0	7.4		75.6	9.8	27.6	7.4		0.4
Eunotia sp.					5.9				
Rhoicosphenia curvata			5.6				2.5	10.8	10.3
Cocconeis pediculus	8.5		46.9				37.2	34.5	35.2
Cocconeis placentula			5.6		34.6			11.8	15.5
Navicula accomoda	3.0	0.5	0.5			3.8	1.0		
Navicula auriculata	0.5				0.5	0.5			
Navicula capitata	2.5		0.5				1.0		
Navicula cryptocephala var. veneta			1.4		0.5				
Navicula heufleri	5.0		2.3		1.0	2.4	3.4	2.5	0.9
Navicula lanceolata	4.0		0.9	2.2	1.0	1.9	3.9	3.4	3.4
Navicula pelliculosa		0.5							
Navicula pupula	1.0								
Navicula pygmaea		0.5	1.9	0.7					
Navicula radiosa			0.5		7.3	3.3	6.9		
Navicula salinarum	1.0		0.9	0.4	1.0	1.9		0.5	2.1
Navicula symmetrica	3.0					5.2			0.9
Navicula tridentula				0.4					
Navicula viridula var. linearis							3.9		
Navicula sp.								9.9	
Pinnularia braunii				0.4					
Pinnularia sp.			0.5						
Caloneis bacillum					0.5	1.0			
Anomoeoneis vitrea						1.0			
Diploneis sp.	2.5			0.7	5.9	5.2			
Stauroneis sp.					0.5				

*For an explanation of terminology in table headings, see the appendix.

Table 34 (Cont'd)

Taxa	Stations: D	F	P	Y	Z
Melosira granulata					
Melosira varians					
Cyclotella atomus					
Cyclotella meneghiniana					
Cyclotella stelligera					
Stephanodiscus minutus		0.5			
Stephanodiscus invisitatus					
Fragilaria pellucida	.05				
Meridion circulare					
Synedra delicatissima					
Synedra rumpens					
Synedra ulna	7.7	9.1	10.1	5.9	4.1
Achnanthes lanceolata		1.0			
Achnanthes microcephala	12.0	43.9	43.4	20.2	47.2
Eunotia sp.					
Eunotia flevuosa	12.5	0.5		0.4	
Rhoicosphenia curvata					
Ampiusa pellucida				0.8	
Cocconeis pediculus	1.0	25.2			
Cocconeis placentula					
Navicula accomoda					
Navicula auriculata					
Navicula capitata					
Navicula cryptocephala var. veneta		0.5	1.5	13.5	
Navicula heufleri	1.0				
Navicula lanceolata			4.0	1.7	1.0
Navicula pelliculosa					
Navicula pupula	2.5				
Navicula pygmaea					
Navicula radiosa	0.5				
Navicula salinarum					
Navicula symmetrica					
Navicula tridentula					
Navicula viridula var. linearis					
Navicula sp.					
Pinnularia braunii					
Pinnularia sp.					
Caloneis bacillum		0.5	1.0		1.0
Caloneis lewisii				1.3	
Anomoeoneis vitrea	1.4				
Diploneis sp.					
Diploneis ovalis	0.5	0.5			
Stauroneis phoenicentron			0.5		

Table 34 (Cont'd)

Taxa	Stations: S	L	T	O	N_1	N_2	A	I	J
Gyrosigma sp.	0.5								
Mastogloia smithii				0.4					
Gomphonema parvuium	1.0	34.3	0.9	1.9	1.5	4.3	2.0	1.0	0.9
Cymbella cistula						0.5			
Cymbella cymbiformis			0.5		0.5	1.9			
Cymbella microcephala	1.5		0.5	13.0	1.0	0.5			0.4
Cymbella minuta	3.5	37.3	2.8	2.6	4.4	7.6	0.5		3.0
Amphora ovalis	1.5		1.4			1.0	10.3	1.5	0.9
Amphora veneta						0.5			
Rhopalodia gibberula	0.5								
Hantzschia amphioxys	1.0							1.5	0.4
Nitzschia amphibia	1.0	1.5	1.4	0.4	0.5	1.0	1.0		
Nitzschia apiculata		1.0	2.8				5.9		
Nitzschia dissipata	2.5				0.5		3.4		1.7
Nitzschia frustulum		0.5			0.5	0.5			
Nitzschia hungarica	3.5								
Nitzschia linearis		1.0	0.9	1.5	2.4	2.9	2.0	1.0	5.2
Nitzschia palea	5.5	7.8	7.0		4.4	5.7	2.0	14.8	13.3
Nitzschia sigmoidea	3.5								
Nitzschia tryblionella		1.0							0.9
Nitzschia tryblionella var. levidensis	4.0				1.0			0.5	
Nitzschia sp.								1.0	2.6
Denticula elegans					0.5				
Cymatopleura solea							2.0		
Surirella angusta			2.3		0.5		0.5	1.3	
Surirella biseriata	1.0		0.5				1.0		
Surirella minuta	1.0				0.5	1.9			
Surirella ovata								3.4	0.9
Surirella ovata var. pinnata						1.0			
Surirella ovalis	5.0		8.9						
Surirella robusta							0.5		
Surirella spiralis							0.5		
Total No. Taxa	30	16	26	13	30	30	23	17	21

Table 34 (Cont'd)

Taxa	Stations: D	F	P	Y	Z
Gyrosigma sp.					
Gurosiama scalorsides	0.5				
Mastogloia smithii					
Gomphonema parvulum			5.0	8.9	6.6
Cymbella cistula	0.5				
Cymbella cymbiformis			0.5		
Cymbella microcephala	26.9	3.0	2.5	3.4	2.0
Cymbella minuta		14.6	31.3	38.0	10.7
Cymbella tumida	14.9				
Amphora normanii					1.0
Amphora veneta					
Rhopalodia gibberula					
Hantzschia amphioxys					
Nitzschia amphibia					0.5
Nitzschia apiculata					
Nitzschia denticula	15.4				
Nitzschia dissipata					
Nitzschia frustulum		0.5			
Nitzschia hungarica					
Nitzschia linearis	2.4			2.5	1.0
Nitzschia palea				3.4	
Nitzschia sigmoides					
Nitzschia tryblionella					
Nitzschia tryblionella var. levidensis	0.5				
Nitzschia sp.	1.0				
Denticula elegans					24.9
Cymatoplaura solea					
Surirella angusta	0.5				
Surirella biseriata					
Surirella minuta					
Surirella ovata					
Surirella ovata var. pinnata					
Surirella ovalis					
Surirella robusta					
Surirella spiralis					
Total No. Taxa	19	12	10	12	11

Table 35

Periphytic Diatoms--Dominant Forms--Fort Hood--Fall

Station*	Total No. Species	Dominant Diatom	% of Total	Subdominant Diatom	% of Total
R Upper Leon River	52	Nitzschia palea	26.6	Nitzschia amphibia	23.7
S Lower Leon River	15	Rhopalodia gibba	45.1	Fragilaria sp. A	42.1
K Upper Cowhouse Creek	43	Nitzschia palea	58.3	Anomoeoneis vitrea	20.3
L Mid Cowhouse Creek	22	Nitzschia palea	26.1	Nitzschia frustulum	19.7
T Lower Cowhouse Creek	42	Nitzschia palea	35.3	Cyclotella meneghiniana	31.8
O Mid Table Rock Creek	36	Cyclotella meneghiniana	14.3	Nitzschia palea	12.0
N Lower North Nolan Creek	23	Anomoeoneis vitrea	44.4	Nitzschia amphibia	26.1
A Lower Clear Creek	22	Achnanthes linearis	25.3	Nitzschia palea	12.9
H Lower Turkey Run Creek	14	Nitzschia amphibia	44.3	Cyclotella meneghiniana	23.8
I Upper House Creek	28	Navicula heufleri	21.0	Nitzschia palea	16.7
J Lower House Creek	11	Fragilaria sp. a	58.7	Nitzschia amphibia	28.6

*For an explanation of terminology in table headings, see the appendix.

Table 36

Periphytic Diatoms--Dominant Forms--Fort Hood--Spring

	Station*	Total No. of Species	Dominant Diatom	% of Total	Subdominant Diatom	% of Total
R	Upper Leon River	0				
S	Lower Leon River	30	Synedra Ulna	17.4	Achnanthes Microcephala	10.0
K	Upper Cowhouse Creek	0				
L	Mid Cowhouse Creek	16	Cymbella Minuta	37.3	Gomphomema Parvulum	34.3
T	Lower Cowhouse Creek	26	Cocconeis Pediculus	46.9	Syrirella Ovalis	8.9
O	Mid-Table Creek	13	Achnanthes Microcephala	75.6	Cymbella Microcephala	13.0
N_1	Lower Nolan Creek	30	Cocconeis Placentula	34.6	Achnanthes Microcephala	9.8
N_2	Upper Nolan Creek	30	Achnantes Microcephala	27.6	Cymbella Minuta	7.6
A	Lower Clear Creek	23	Cocconeis Pediculus	37.2	Amphora Ovalis	10.3
H	Lower Turkey Run Creek	0				
I	Upper House Creek	17	Cocconeis Pediculus	34.5	Rhoicospheni Curvata	10.8
J	Lower House Creek	21	Cocconeis Pediculus	35.2	Nitzschia Palea	13.3
D	Lower Reese Creek	19	Cymbella Microcephala	26.9	Cymbella Tumida	14.9
F	Upper Clear Creek	12	Acholanthus Microcephala	43.9	Cocconeis Pediculus	25.2
P	Turnover Creek	10	Achnanthes Microcephala	43.4	Cymbella Minuta	31.3
Y	Hensen Creek	12	Cymbella Minuta	38.0	Achnanthes Microcephala	20.2
Z	Owl Creek	11	Achnanthes Microcephala	47.2	Denticula Elegans	24.9

*For an explanation of terminology in table headings, see the appendix.

Table 37

Aquatic and Marginal Vegetation Collected from Aquatic Habitats at Fort Hood, Texas -- Spring and Fall

Scientific Name*	Common Name	Station: O	N1	N2	F	A	D	H	Z
Acanthaceae									
Justicia americana	American waterwillow								X
Alismataceae									
Sagittaria platyphylla	Arrowhead					Ⓧ			
Characeae									
Chara sp.	Stonewort	X	X		Ⓧ		X		X
Cyperaceae									
Eleocharis montevidensis	Spikerush								X
Haloragaceae									
Myriophyllum sp.	Water-milfoil			Ⓧ					
Najacaceae									
Najas sp.	Water-nymph	X							
Potamogentonaceae									
Potamogeton sp.	Pondweed			X					
Primulaceae									
Samolus parviflorus	Water pimpernel		X						
Scrophulariaceae									
Veronica sp.	Speedwell							X	
Zannichelliaceae									
Zannichellia pelustris	Common poolmat	X				X			
Bacopa	Water Hyssop			0		0			
Lemna	Duckweed					0			

*For an explanation of terminology in table headings, see the appendix.

Comments:
X = observed in Spring
0 - observed in Fall
Ⓧ - observed in both Spring and Fall

Table 38

Zooplankton--Number/L--Fort Hood--Fall

Taxa* Stations:	B1	B2	B3	B4	R	S	K	T	O	N1	N2	F	A	D	I1	I
PROTOZOA																
Difflugia sp.			8.9			12.5	59.4						1.9	16.9		
NEMATODA			0.5					0.9		104.9				0.9		1.2
ROTIFERA																
Anuraeopsis fissa				1.9	211.9					1153.8	337.8					
Ascomorpha sp.					1129.9						1013.4					
Asplanchna brightwelli								37.5					3.8			
Asplanchna priodenia							21.9									
Brachionus angularis	12.2	17.8	12.2	3.8	141.2		206.2	9.4				131.2	35.6	2.8	120.9	
Brachionus bidentata	12.2	1.9							3.1				5.6	6.6		
Brachionus budapestinensis	39.4	23.4						7.5								
Brachionus caudatus								258.8					3.8			
Brachionus bavanaensis					1412.4		262.5	2.8	1437.5	1958.0			7.5		13.1	60.0
Brachionus patulus						6.2	3.1		203.1		33.8				2.8	6.2
Brachionus quadridentatus								0.9	9.4				5.6	11.2	2.8	2.5
Brachionus rubens															12.2	
Cephalodella sp.									6.2				5.6	42.2	18.8	1.2
Cephalodella sp. 1									18.8			25.0	20.6	13.1		1.2
Colorella sp.					35.3											
Conochiloides dossuarius			0.5	8.4			162.5	3.8								
Conochilus unicornis	2.8	2.8	4.2			175.0	9.4			35.0					0.9	
Epiphanes macroura						18.8			31.2							
Euchlanis dilatata												6.2			0.9	
Euchlanis sp.					600.3											
Filinia longiseta	6.6	7.5	5.2	0.9	35.3	31.2			1181.2	35.0			146.2	0.9	27.2	23.8
Filinia opoliensis							34.4								4.7	
Gastropus hyptopus																

*For an explanation of terminology in table headings, see the appendix.

Table 38 (Cont'd)

Taxa	B1	B2	B3	B4	R	S	K	T	O	N1	N2	F	A	D	I1	I
ROTIFERA (Cont'd)																
Hexarthra mira		1.9	1.9	10.3			12.5								0.9	
Keratella cochlearia	37.5	38.4	45.0	86.2			46.9		34.4	1328.7	979.6		7.5			1.2
Lecane hastata						25.0	3.1	0.9	9.4						17.8	1.2
Lecane luna						12.5										1.2
Lecane ungulata																
Lecane sp. C	4.7	1.9		0.9			3.1		346.9	104.9		6.2				
Lecane sp. X					70.6					69.9		137.5	20.6	8.4	114.4	22.5
Lepadella sp.					353.1		3.1		6.2							
Lophocharis sp.							3.1							0.9	1.9	
Monommata sp.																
Monostyla bulla						12.5	3.1								0.9	
Monostyla closterocerca					35.3								3.8			
Monostyla quadridentata					141.2						101.3				0.9	
Platyias quadricornis																
Ploesoma hudsoni			1.4	19.7						35.0						
Plocsoma truncatum																
Polyarthra vulgaris	29.1	41.2	21.6	96.6	706.2	75.0	15.6	10.3	756.2	8671.3	1317.4		46.9			
Rotaria sp.	2.8	3.8			565.0	6.2		5.6	31.2	35.0				0.9	2.8	3.8
Scaridium longicaudum					35.3								39.4	60.0	30.0	36.2
Synchaeta pectinata				0.9												
Synchaeta stylata	24.4	55.3	9.8	18.8			9.4						3.8		24.4	
Testudinella patina							6.2		12.5						0.9	
Trichocerca multicrinis				11.2											1.9	1.2
Trichocerca similis				2.8	70.6					6643.4	776.9					1.2
Trichocerca sp.	5.6	13.1	0.9		1800.8	12.5	3.1	8.4	156.2	2062.9	1418.8		1.9	0.9		7.5
Trichocerca sp. B	3.8	5.6							3.1							
Trichotria sp.													1.9			
Unidentifiable Bdelloid															10.3	
Unknown Rotifer #3	15.0	1.9			35.3			1.9	59.4	104.9		6.2	52.5		25.1	57.5

Table 38 (Cont'd)

Taxa	Stations: B1	B2	B3	B4	R	S	K	T	O	N1	N2	F	A	D	11	1
OSTRACODA					35.3				3.1			6.2	5.6	1.9	4.7	1.2
CLADOCERA												62.5				
Bosmina longirostris						75.0	28.1					262.5				
Ceriodaphnia lacustris						12.5		0.9				81.2				
Ceriodaphnia pulchella												18.8			0.9	1.2
Ceriodaphnia rigaudi																3.8
Chydorus sphaericus																
Diaphanosoma leuchtenbergianum							15.6	9.4		35.0			1.9			
Hyocryptus spinifer												6.2	3.8			
Macrothrix hirsuticornis																1.2
Moina brachiata									131.2			6.2				
Scapholeberis kingii																
Simocephalus serrulatus						6.2										
COPEPODA																
Copepod nauplii	1.9		2.3	31.9	494.3	543.8	268.8	15.9	25.0	979.0	2128.1	2056.2	50.6	151.9	21.6	46.2
Calanoid copepodid							59.4		3.1							1.2
Cyclopoid copepodid					35.3	300.0	40.6	2.8	9.4	419.6	337.8	450.0	26.2	38.4	3.8	8.8
Cyclops sp.							9.4					18.8	1.9	22.5	0.9	
Diaptomus pallidus							15.6		3.1							
Mesocyclops edax														22.5		
OLIGOCHAETA														1.9		
DIPTERA																
Chaoborus sp.								4.7				6.2	3.8	2.4	2.8	1.2
Total (No./2)	198.0	216.5	114.4	294.3	7944.6	1324.9	1306.1	382.4	4480.9	23776.3	8444.9	3287.1	508.3	407.2	471.4	294.4
Total (No. Taxa)	14	14	13	14	20	16	26	18	24	17	10	17	26	20	29	25

Table 39

Zooplankton Densities--Number/L--Fort Hood--Spring

Taxa* Stations:	B1	B2	B3	B4	R	S	L	K	T	O	N1	N2	F	A	D	H	I	J	Z	Y	P
PROTOZOA																					
Codonella crotera	3.1	2.5		0.6	1.0							1.9									
NEMATODA					2.8	3.6	0.2				0.2									<0.1	
ROTIFERA																					
Ascomorpha sp.			3.1	3.8																	
Bdelloidea							<0.1	0.1		<0.1	0.2		0.1	0.1			0.3	0.2			
Brachionus angularis	0.6	7.5	0.6		8.2	3.2		<0.1	4.5			0.6							0.1	0.2	0.2
Brachionus bennini					0.2																<0.1
Brachionus bidentata						1.3														<0.1	
Brachionus calyciflorus					0.5	0.6														0.1	
Brachionus nilsoni					0.2														<0.1		
Brachionus patulus	0.6				0.2	0.3	<0.1													<0.1	<0.1
Brachionus quadridentatus					1.2	2.3		<0.1	0.2												
Brachionus variabilis								<0.1												<0.1	0.1
Cephalodella sp.			0.6				<0.1						<0.1		<0.1	<0.1	0.2	<0.1			
Collotheca sp.		1.9	0.6	1.2								0.6									
Conochiloides dossuarius	1.9	2.5		0.6																	
Conochilus unicornis	2.5	3.8	0.6	6.2	0.2			<0.1	0.2			1.2									
Epiphanes senta													0.2			0.8					<0.1
Euchlanis dilatata			0.6			0.3							<0.1			<0.1	0.2			<0.1	
Filinia longiseta		1.2			3.2	3.9		0.2				1.9								0.4	<0.1
Gastropus hyptopus																0.4					
Hexarthra mira		13.1				0.3			2.5			1.2									
Keratella cochlearis	25.6	45.0	48.8	25.0	4.2	3.9	0.1	0.1	17.5		1.4	6.9			<0.1					0.1	<0.1
Keratella earlinae	15.6	16.9	1.9	1.9	1.0			0.1	0.2			5.0									

*For an explanation of terminology in table headings, see the appendix.

Table 39 (Cont'd)

Taxa	Stations:	B1	B2	B3	B4	R	S	L	K	T	O	N1	N2	F	A	D	H	I	J	Z	Y	P
Keratella quadrata v. valga						2.0			0.1												0.2	
Lecane crepida				0.6						0.2									<0.1			
Lecane luna											<0.1					<0.1					<0.1
Lecane ohioensis														<0.1						<0.1	
Lecane pycina																	<0.1				
Lepadella sp.						0.5	0.3		<0.1		<0.1						<0.1	0.1	<0.1		0.1
Lophocharis sp.						0.2			<0.1												
Monostyla bulla				0.6			0.3	0.1	0.1	0.5									<0.1		0.1	0.2
Monostyla closterocerca																<0.1			<0.1			
Monostyla crenata														<0.1								
Monostyla lunaris								<0.1	<0.1	0.2		0.2								0.2		
Platylas quadricornis				0.6													<0.1					
Polyarthra dolicoptera			0.6																			
Polyarthra euryptera		11.2	1.9		0.6								0.6									
Polyarthra vulgaris		33.1	73.1	24.4	40.0		0.6		<0.1	11.8		0.7	10.0									
Pompholyx sulcata						1.0						0.9	5.0									
Rotaria sp.				1.2		2.2	1.0	0.2	0.1	1.8	0.4			0.2	<0.1		0.6	0.4	<0.1	<0.1	0.2	0.1
Synchaeta oblonga				100.6						0.8												
Synchaeta pectinata			1.2		5.0	0.2							0.6									
Synchaeta stylata										0.5												
Testudinella mucronata						0.2																
Testudinella patina							0.3		<0.1			0.2										<0.1
Trichocerea multicrinia						0.2				0.5							<0.1	0.1			<0.1	
Trichocerca sp.					1.2		0.3													<0.1		
Trichotria tetractis						0.2		<0.1							<0.1	0.1						
Unknown Rotifer #3							1.0	0.2	0.2	1.2		0.4		0.1	<0.1	0.2	0.2		0.1	<0.1		0.1
Wolga spinifera										0.5						0.1			0.2	<0.1		

Table 39 (Cont'd)

Taxa	Stations	B1	B2	B3	B4	R	S	L	K	T	O	N1	N2	F	A	D	H	I	J	Z	Y	P
OSTRACODA						0.2	1.0					0.9		<0.1		<0.1		0.1				
CLADOCERA																						
Alona costata											<0.1	0.2				0.1						
Alona guttata							0.3	<0.1		0.2				0.2			0.1					
Bosmina longirostris		6.9	11.2	3.1	22.5	1.0	0.6		<0.1			0.7	13.1								<0.1	<0.1
Ceriodaphnia lacustris		4.4			20.6							0.2	2.5									
Chydoris sphaericus				2.5		0.2	0.3															
Daphnia ambigua					0.6								0.6									
Daphnia laevis							0.6					1.0	1.2									
Daphnia sp.													1.9									
Diaphanosoma brachyurum													1.2									
Macrothrix hirsuticornis						0.2															<0.1	
COPEPODA																						
Copepod nauplii		12.5	23.1	21.9	36.2	16.5	9.4	0.3	0.4	8.2	0.1	3.7	83.8	1.1	<0.1	0.2	0.4	0.5	0.2	0.1	0.4	0.8
Calanoid copepodid		2.5			0.6	0.8	0.3					0.2	3.8								<0.1	
Cyclopoid copepodid		8.1	2.5	2.5	5.0	3.2	3.2		0.2	3.5		5.1	43.8	0.1						<0.1	0.4	<0.1
Harpacticoid copepodid												0.2										
Cyclops sp.													3.1									
Diaptomus sp.						0.8							1.9									
DIPTERA							0.3		0.4	2.0	0.1	1.6	0.6	0.4	0.2	0.1	0.4	1.1		0.2		0.2
Total (No./ℓ)		128.6	208.0	214.8	171.6	52.5	39.5	1.4	2.5	57.0	0.8	18.0	193.0	2.6	0.5	1.2	3.1	3.0	1.0	0.9	2.6	2.2
Total (No. Taxa)		14	16	18	17	29	26	12	21	20	7	18	24	13	6	12	12	9	10	10	11	17

Table 40

Zooplankton--Relative Abundance (%)--Fort Hood--Fall

Station*	Total No./L	Rotifera	Cladocera	Copepoda	Other[a]
B1 Belton Lake	198.0	99.0	-	1.0	-
B2 Belton Lake	216.5	100.0	-	-	-
B3 Belton Lake	114.4	89.8	-	2.0	8.2
B4 Belton Lake	294.3	89.2	-	10.8	-
R Upper Leon River[b]	7944.6	92.9	-	6.7	0.4
S Lower Leon River	1324.9	28.3	7.1	63.7	0.9
K Upper Cowhouse Creek	1306.1	62.0	3.3	30.2	4.5
T Lower Cowhouse Creek	382.4	91.0	2.7	4.9	1.5
O Table Rock Creek	4480.9	96.1	2.9	0.9	0.1
N1 Lower North Nolan Creek[b]	23776.3	93.5	0.1	5.9	0.4
N2 Upper North Nolan Creek[b]	8444.9	70.8	-	25.2	4.0
F Upper Clear Creek	3287.1	9.5	13.3	76.8	0.4
A Lower Clear Creek	508.3	81.2	1.1	15.5	2.2
D Lower Reese Creek	407.2	36.3	-	57.8	5.9
H Lower Turkey Run Creek	471.4	92.6	0.2	5.6	1.6
I Upper House Creek	294.4	77.6	2.1	19.1	1.2

*For an explanation of terminology in table headings, see the appendix.

Comments:

[a]Includes Nematoda, Protozoa, Ostracoda, Diptera, Oligochaeta
[b]Grab samples

Table 41

Zooplankton--Relative Abundance (%) --Fort Hood--Spring

TAXA*	B1	B2	B3	B4	R	S	L	K	T	O	N1	N2	F	A	D	H	I	J	Z	Y	P
PROTOZOA	2.4	1.2		0.3	1.9							1.0									
NEMATODA					5.3	4.1	14.3				1.1									1.9	
ROTIFERA	70.8	81.1	86	49.8	49.1	50.4	78.6	76	75.6	87.5	23.3	17.4	38.5	80	66.1	83.9	43.3	80	88.9	61.54	51.11
OSTRACODA					0.4	2.5					5		3.8		8.3		3.3				
CLADOCERA	8.8	5.4	2.6	25.5	2.7	4.6	7.1	4	0.4	12.5	11.7	10.6	7.7		16.7					3.85	2.22
COPEPODA	18	12.3	11.4	24.4	39	32.7	21.4	24	20.5	12.5	51.1	70.7	46.1	20	16.7	12.9	16.6	20	22.2	32.69	37.78
DIPTERA						39.5		16	3.5	12.5	8.9	0.3	15.4	40	8.3	12.9	36.7		22.2		8.89
Total # of Organisms/liter	128.6	208	214.8	171.6	52.5	39.5	1.4	2.5	57	0.8	18	193	2.6	0.5	1.2	3.1	3	1	0.9	2.6	2.25
Total # of Taxa	14	16	18	17	29	26	12	21	20	7	18	24	13	6	12	12	9	10	10	19	17

*For an explanation of terminology in table headings, see the appendix.

Table 42

Macroinvertebrates--Numbers/m^2 Collected by Dredge (E) and Surber (S)--Fort Hood--Fall

Taxa*	Station:	B1	B2	B3	B4	R	T	O	N1	N2	F	D	H	I	J
	Sampling Gear:	E	E	E	E	E	E	E	E	E	E	E	S	S	E
NEMATA							43								
ANNELIDA															
Oligochaeta															
Branchiura sowerbyi						194	259	4827	2241	711		670		86	3857
Dero digitata							86				172	259		16	
Dero nivea														5	
Dero vagus							43								
Limnodrilus cervix						65	172					129		43	22
Limnodrilus hoffmeisteri														5	22
Limnodrilus maumeensis						22					86				
Limnodrilus profundicola														38	
Limnodrilus spiralis							431			43	86	86	5	11	86
Lumbriculidae							43								
Naididae							345		43	22		172		16	
Tubificidae (immature)						603	4095	388	216	108	216	1595	16	204	1961
Total						884	5474	5215	2500	884	560	2911	21	424	5215
Hirudinea															22
ARTHROPODA															
Crustacea															
Amphipoda															
Hyallela azteca														5	

*For an explanation of terminology in table headings, see the appendix.

Table 42 (Cont'd)

Taxa	Station:	B1	B2	B3	B4	R	T	O	N1	N2	F	D	H	I	J
	Sampling Gear:	E	E	E	E	E	E	E	E	E	E	E	S	S	E
ARTHROPODA (cont'd)															
Insecta															
Ephemeroptera															
Baetidae															
Baetis sp.														5	
Caenis sp.						22	86							32	
Callibaetis sp.														16	
Hexagenia limbata														11	
Total						22	86			22				69	22
Odonata										22					
Erpetogomphus sp.													5		
Lestidae													5		
Macrothemus sp.						22							5		
Total						22							15		
Hemiptera															
Trichocorixa sp.													5		
Cerris sp.													5		
Total													10		
Neuroptera															
Corydalus sp.														16	
Sialis sp.															43
Total														16	43
Coleoptera															
Elodes sp.													5		
Laccornis sp.								43							
Helochares sp.													5		
Stenelmis sp.						22								11	22
Tropisternus sp.													5		
Total						22		43					15	11	22

Table 42 (Cont'd)

Taxa	Station:	B1	B2	B3	B4	R	T	O	N1	N2	F	D	H	I	J
	Sampling Gear:	E	E	E	E	E	E	E	E	E	E	E	S	S	E
ARTHROPODA (cont'd)															
Insecta (cont'd)															
Trichoptera															
Orthotrichia sp.							43								
Diptera															
Chaoborus punctipennis			409	230		172			172	65	43	345			
Chironomus thummi group			22			86	43				302	431	5	366	
Clinotanypus sp.						43									
Coelotanypus sp.		344	3082	460	29		1034	474	43	22	43				
Cricotopus sp. A														22	
Cricotopus exilis														16	
Cryptochironomus sp.				57			43							5	
Cryptocladopelma sp.						43				43	86				
Cryptotendipes sp.									43						
Culicoidinae						86			43	22					
Dicrotendipes sp.													38	59	
Einfeldia sp.									43						
Glyptotendipes dreisbachi							86								
Glyptotendipes sp.														38	
Goeldichironomus sp.														54	
Lauterborniella sp.						22									
Parachironomus sp.						43									
Paracladopelma sp.							43								
Pentaneura sp.			22										5	129	22
Polypedilum illinoense					57	22	129			22			11	349	
Procladius sp.			43	115			517			65	43	22			
Psectrotanypus sp.										22					
Tabanus sp.														5	

Table 42 (Cont'd)

Taxa	Station:	B1	B2	G3	B4	R	T	O	N1	N2	F	D	H	I	J
	Sampling Gear:	E	E	E	E	E	E	E	E	E	E	E	S	S	E
ARTHROPODA (cont'd)															
Insecta (cont'd)															
Diptera (cont'd)															
Tanypus punctipennis			129			409	129		43	194	690	43			
Tanypus stellatus		14	409		57	237	1078	5215	517	388	129	690			259
Tanytarsini							43								
Tanytarsus flavellus															22
Tanytarsus sp.			65			22		216							151
Total		358	4181	862	143	1185	3145	5905	904	843	1336	1531	59	1043	454
MOLLUSCA															
Gastropoda															
Helisoma sp.											129				86
Physa sp.														199	65
Total											129			199	151
Pelecypoda															
Sphaerium sp.						22					86				280
Total (No./m^2)		358	4181	862	143	2157	8836	11163	3404	1749	2111	4442	120	1762	6942
Total (No. Taxa)		2	8	4	3	19	22	6	10	14	13	11	14	27	16
Species Diversity		0.162	0.954	1.155	1.056	2.425	1.997	1.068	1.464	1.866	2.238	1.932	0.234	2.493	1.329

Table 43

Densities (No./m^2) of Macroinvertebrates Collected by Ekman Dredge (E) and Surber Sampler (S)--
Fort Hood, Spring

Taxa*	Station:	O	N1	N2	D	H	I	J
	Sampling Gear:	E	E	E	E	S	S	E
TURBELLARIA								
Dugesia sp.					129			
ANNELIDA								
Oligochaeta								
Brachiura sowerbyi		172	72	573	57			1,494
Dero nivea			72		72			201
Limnodrilus cevix		244				11		57
Limnodrilus hoffmeisteri		158					5	29
Limnodrilus profundicola		29						
Limnodrilus spiralis		776		19		16		144
Lumbriculidae			29					
Naididae			86		331			115
Tubificidae (immature)		5,877	14	19	29	102	22	7,326
Hirudinea			14		57			
ARTHUROPODA								
Crustacea								
Amphipoda								
Hyalella azteca			43	76	14			
Insecta								
Ephemeroptera								
Caenis sp.		29		19				
Hexagenia limbata			72	210				29
Odonata								
Argia sp.						5	5	
Agrionidae			14	19				

*For an explanation of terminology in table headings, see the appendix.

Table 43 (Cont'd)

Taxa	Station:	O	N1	N2	D	H	I	J
	Sampling Gear:	E	E	E	E	S	S	E
Megaloptera								
Sialis sp.			29	38				
Trichoptera								
Cheomatopsyche sp.			29			16	16	
Diptera								
Ablabesmyia sp.			29	115			5	
Ceratopogonidae		14						
Chironomus thummi group					144			
Coelotanypus sp.			14	38				
Conchapelopia sp.						5	22	
Cricotopus sp. A						22		
Cricotopus sp. B							11	
Cricotopus fugax				57		43		
Cryptochironomus sp.		14		38				
Dicrotendipes sp.			43	38	43			
Parachironomus sp.				19				
Polypedilum sp.		29	14	115	57	22	5	172
Procladius sp.			72		43			144
Rheotanytarsus sp.		14						
Simulium sp.				191				
Stictochironomus sp.		29						
Tabanus sp.				19				
Tanytarsus sp.			345	57	29			
MOLLUSCA								
Pelecypoda								
Sphaerlidae		72	29	554				862
Castropoda								
Gyralus sp.			43	19				115

Table 43 (Cont'd)

Taxa	Station:	O	N1	N2	D	H	I	J
	Sampling Gear:	E	E	E	E	S	S	E
Helisoma sp.			29	19	560			29
Lymnaca sp.				19	57			
Physa sp.		14	86	229	101		11	29
Total (No./m^2)		7,471	1,178	2,500	1,723	242	102	10,746
Total (No. taxa)		14	21	23	15	9	9	14
Diversity		0.882	2.598	2.445	2.194	1.767	2.024	1.183

Taxa	Station:	S	L	A	A	P	Z
	Sampling Gear:	E	S	E	S	E	S
Megaloptera							
Sialis sp.							
Trichoptera							
Cheumatopsyche sp.					554		65
Chimarra sp.					48		43
Orthetrichia sp.					75	43	
Diptera							
Ablabesmyia sp.				29			
Ceratopogonidae				14		72	
Chironomus thummi group				29		14	
Coelotanypus sp.							
Conchapelopia sp.					43	57	
Cricotopus sp.					156	29	
Cricotopus sp. B							
Cricotopus fugax							
Cryptochironomus sp.				43	5	72	

Table 43 (Cont'd)

Taxa	Station: / Sampling Gear:	S E	L S	A E	A S	P E	Z S
Dicrotendipes sp.							
Glyptotendipes sp.				86	5	115	
Harnischia sp.						57	
Polypedilum sp.				57		43	
Procladius sp.							5
Rheotanytarsus sp.					328		5
Simulium sp.					59		436
Stictochironomus sp.				14			
Tabanus sp.							
Tanypus sp.				43			
Tanytarsus sp.				43		86	
MOLLUSCA							
Pelecypoda							
Sphaeriidae		14		43	5	29	
Gastropoda							
Gyraulus sp.		14					
Helisoma sp.		14		43		43	
Lymnaea sp.						14	
Physa sp.		57		72		101	27
Total (No./m^2)		214	21	3275	1331	2398	612
Total (No. taxa)		8	3	20	16	19	10
Diversity		1.9301	1.0221	1.4648	1.7465	1.9812	1.0956

Table 44

Macroinvertebrates--Numbers Collected by Dip Net--Fort Hood--Fall

Taxa*	Station:	R	S	K	L	T	O	N1	N2	F	A	D	H	I	J
PORIFERA															
Demospongia															
Spongilla sp.		1													
COELENTERATA															
Hydrozoa															
Hydra sp.										3					
PLATYHELMINTHES															
Turbellaria															
Dugesia tigrina							5	1			8			1	
ECTOPROCTA															
Phytolactolaemata															
Plumatella repens		1									1				
ANNELIDA															
Oligochaeta															
Branchiura sowerbyi					3		15				9	1		2	
Dero digitata						1		1		7	1		1		
Naididae											1				
Nais variabilis														1	
Nais sp.									1						
Tubificidae (immature)						1									1
Hirudinea			1	1			1		1		1				1

*For an explanation of terminology in table headings, see the appendix.

Table 44 (Cont'd)

Taxa	Station:	R	S	K	L	T	O	N1	N2	F	A	D	H	I	J
ARTHROPODA															
Arachnida															
Acari															
Albia sp.							2								
Arrenurus sp.							3		1	1				1	
Atractides sp.							6								
Eylais sp.		1	1												
Frontipoda sp.										1					
Lebertina sp.									7	6				4	
Mideopsis sp.							12								
Crustacea															
Conchostraca															
Lynceus sp.			1								4			1	
Amphipoda															
Hyalella azteca			7	1					1	3	2	1			
Decapoda															
Astacidae												1			
Palaemonetes sp.			1												
Insecta															
Ephemeroptera															
Baetis sp.					1				3	1		3			
Caenis sp.		1	2	2	6			2	5		15		2		5
Callibaetis sp.					1	5					1	1		5	
Hexagenia bilineata						1									
Stenonema tripunctatum				8	4										

Table 44 (Cont'd)

Taxa	Station: R	S	K	L	T	O	N1	N2	F	A	D	H	I	J
ARTHROPODA (cont'd)														
Insecta (cont'd)														
Odonata														
Archilestes sp.			1								3			
Argia sp.	4											8	6	2
Brechmorhoga sp.												2		
Erpetogomphus sp.										1				
Erythemis sp.		1								1				
Gomphus sp.								4	6			3		1
Lepthemis sp.														1
Lestes sp.		1		1				8				2		
Lestidae									1	1	1			
Libellula sp.									1	2			2	2
Macrodiplax sp.														1
Macromia sp.												1		
Nasiaeschna sp.												1	1	
Neurocordulia sp.							1	1	2	1	4			
Orthemis sp.												1		
Plathemis sp.													6	
Tauriphila sp.													1	
Tetragoneuria sp.			3						2		5			
Hemiptera														
Ambrysus sp.												1		
Belostoma sp.		5			1					3			2	1
Corixidae (immature)					13									
Gerridae (immature)								1				1		
Gerris sp.													1	
Hydrometra sp.														1
Nepa sp.													1	
Ranatra sp.								1						
Trepobates sp.										1				
Trichocorixa sp.		1			13								1	

Table 44 (Cont'd)

Taxa	Station:	R	S	K	L	T	O	N1	N2	F	A	D	H	I	J
ARTHROPODA (cont'd)															
Insecta (cont'd)															
Diptera															
Chaoborus punctipennis												1			
Chironomus "thummi" group					12					1	2	5	5	19	3
Chrysops sp.												2	1		
Coelotanypus sp.							2			1	1				
Cricotopus sp. A													1	5	
Cryptocladopelma sp.														1	
Dicrotendipes sp.		3				1					1	7	17	11	
Einfeldia sp.													1		
Glyptotendipes dreisbachi		1				2					4		3		
Goeldichironomus sp.					7	3				1	7	5	1		
Parachironomus sp.					1					1					
Pentaneura sp.		1			1	1					6		2		
Phaenopsectra sp.								1							
Polypedilum illinoense											1			22	
Polypedilum sp.													2		
Procladius bellus													1		
Procladius sp.								1		1					
Psorophora sp.										1					
Rheotanytarsus sp.									1				2		
Rhipidia sp.													1		

Table 44 (Cont'd)

Taxa	Station: R	S	K	L	T	O	N1	N2	F	A	D	H	I	J
ANTHROPODA (cont'd)														
Insecta (cont'd)														
Neuroptera														
Corydalus sp.														
Sialis sp.	1							3				4	3	
Coleoptera														
Berosus sp.	2	5		2	6	7		2	1	7	1	2		1
Bidessus sp.										2		1	3	
Dineutus sp.	1						2						1	
Dubiraphia sp.			1			3	8		1	1				2
Elodes sp.				3		1						1		
Enochrus sp.					1								1	
Gyretes sp.					1						3			
Haliplus sp.		2		2						1		2		
Helichus sp.													1	
Helophorus sp.										1				
Laccophilus sp.						1								
Notomicrus sp.					1					2			1	
Peltodytes sp.					1									
Pronoternus sp.										1				
Psephenus sp.	11	1	1	4		1								1
Stenelmis sp.		4		1	3					5			2	
Tropisternus sp.														
Trichoptera														
Orthotrichia sp.	1									11				
Lepidoptera														
Pyralidae													1	

Table 44 (Cont'd)

Taxa	Station:	R	S	K	L	T	O	N1	N2	F	A	D	H	I	J
MOLLUSCA															
Gastropoda															
Ferrisia sp.											1				
Gyraulus sp.					6		2		2	1	3			3	3
Helisoma sp.					2				1	13	3	3			2
Lymnaea sp.					1			2							
Physa sp.		2	2		4	3	5		2	1	18	2	3	5	4
Tropicorbis sp.															1
Pelecypoda															
Amblema sp.		1													
Sphaerildae									11	3	1				
Unionidae (juvenile)		5	1	1	3					1					
Total No. Taxa		16	16	9	21	19	16	9	19	26	40	18	29	31	18

Table 45

Occurrence of Macroinvertebrates--Collected by Dip Net--Fort Hood-- Spring

Taxa*	Station: R	S	K	L	P	T	O	N1	N2	F	A	D	H	I	J	Y	Z
TURBELLARIA																	
Dugesia sp.													3				
ANNELIDA																	
Oligochaeta																	
Brachiura sowerbyi															2		
Tubificidae (immature)										1							
Hirudinea								1				3					
ARTHROPODA																	
Crustacea																	
Amphipoda																	
Hyalella azteca			2				2	4	4	3	10	2			7		
Decapoda																	
Astacidae									1			1					
Archnida																	
Lebertia sp.			1							5							
Insecta																	
Ephemeroptera																	
Baetidae		1			2	1			2	4	6	1				2	1
Baetis sp.										3	1					1	
Caenis sp.		2	2	1	2			1	1	4	1						
Hexagenia limbata								1									
Isonychia sp.				1													
Siphlonurus sp.						6	3		1	1	2				3		
Stenonema tripunctatum									1								
Stenonema pulchellum				1												1	
Stenonema sp. (early instar)																1	

*For an explanation of terminology in table headings, see the appendix.

Table 45 (Cont'd)

Taxa	Station:	R	S	K	L	P	T	O	N1	N2	F	A	D	H	I	J	Y	Z
ARTHROPODA (cont'd)																		
Insecta (cont'd)																		
Odonata																		
Agrionidae				1														
Argia sp.									1	2	1	1		2	2	2		
Enallagama sp.				2				3	3	2	1	1			2	2		4
Erpetogomphus sp.					1					1				3				
Gomphus sp.														1				
Hetaerina sp.												1						
Libellula sp.														2				
Nasiaeschna sp.									1									
Neurocordulia sp.										2								
Pachydiplax sp.									1						2			
Plathemis sp.														1	1			
Sympetrum sp.								1			1					1		
Plecoptera																		
Perlesta sp.			2		5					3	4		3				3	
Trichoptera																		
Cheomatopsyche sp.					3	2		6		2	5	5	5				2	9
Chimarra sp.								1					3			1	1	1
Hemiptera																		
Belostoma Sp.														1	2			
Corixidae		1					4	2	1	1								1
Gerris sp.						1	1	2	1	1	1	1	1		1		1	
Limnogonus sp.									1									
Trepobates sp.				1			1					1				1	1	
Trichocorixa sp.							1											

Table 45 (Cont'd)

Taxa	Station:	R	S	K	L	P	T	O	N1	N2	F	A	D	H	I	J	Y	Z
ARTHROPODA (cont'd)																		
Insecta (cont'd)																		
Coleoptera																		
Agabus sp.																		1
Berosus sp.							1	1				2				1		1
Dineutus sp.			1				2										2	1
Dubiraphia sp.																1		
Enochrus sp.						1									1		1	
Halipus sp.								2							1			
Helicus sp.					2													
Hydrochus sp.												2						
Hydroporus sp.				2				1	3	1				3	2			2
Laccophilus sp.		1																
Tropisternus sp.															1			
Diptera																		
Ablabesmyia sp.																	1	
Cetatopogonidae																1		
Conchapelopia sp.												1				1		
Cricotopus sp. A												1						
Cricotopus fugax						1				1								
Dicrotendipes sp.							1			3								
Eukiefferiella sp.						1												
Polypedilum sp.							4		1	5		6						
Sepedon sp.									1						1			
Simulium sp.			1		1	5				19								2
Stictochironomus sp.							1											1
Tanytarsus sp.							1		1									

Table 45 (Cont'd)

Taxa	Station:	E	S	K	L	P	T	O	N1	N2	F	A	D	H	I	J	Y	Z
MOLLUSCA																		
Pelecypoda										1								
Sphaeriidae									11		1	2				11		
Unionidae																1		
Gastropoda																		
Amnicola sp.			1															
Gyraulus sp.									1					1				
Helisoma sp.								2	2	1			4			1		5
Physa sp.						2		1	11	10	1	2		4	3	1	3	4
Tropicorbis sp.														1				
Total No. Taxa		2	5	8	8	9	12	13	19	22	15	18	9	11	13	15	14	13

Table 46

Fishes--Potential Occurrence--Fort Hood

Species*	Common Name	Leon River	Belton Reservoir	Intermittent Creeks	Cowhouse Creek
Lepisosteus platostomus	Shortnose gar				
Lepisosteus oculatus	Spotted gar				
Lepisosteus osseus	Longnose gar		⊗		0
Dorosoma cepedianum	Gizzard shad		⊗	⊗	X
Dorosoma perenense	Threadfin shad				X
Astyanax mexicanus	Mexican tetra				
Campostoma anomalum	Stoneroller			⊗	
Cyprinus carpio	Carp		0		
Hybopsis aestivalis	Speckled chub				
Notemigonus crysoleucas	Golden shiner			⊗	⊗
Opsopoeodus emiliae	Pugnose minnow				
Phenacobius mirabilis	Suckermouth minnow				
Notropis atherinoides	Emerald shiner				
Notropis potteri	Chub shiner				
Notropis percobromus	Plains shiner				
Notropis buccula	Smalleye shiner				
Notropis buchanani	Ghost shiner			X	0
Notropis lutrensis	Red shiner	⊗	X	⊗	⊗
Notropis oxyrhynchus	Sharpnose shiner				
Notropis shumardi	Silverband shiner				
Notropis venustus	Blacktail shiner	X	X	⊗	⊗
Notropis volucellus	Mimic shiner				
Hybognathus placitus	Plains minnow				
Pimephales promelas	Fathead minnow				
Pimephales vigilax	Bullhead minnow	0	⊗	⊗	⊗
Cycleptus elongatus	Blue sucker				
Carpiodes carpio	River carpsucker		X		
Ictiobus bubalus	Smallmouth buffalo		0		
Moxostoma congestum	Gray redhorse				
Ictalurus melas	Black bullhead			⊗	
Ictalurus natalis	Yellow bullhead			X	
Ictalurus punctatus	Channel catfish		⊗	X	0
Ictalurus furcatus	Blue catfish				
Noturus gyrinus	Tadpole madtom				
Pylodictus olivaris	Flathead catfish		X		
Anguilla rostrata	American eel				
Fundulus kansae	Plains killifish				
Zygonectes notatus	Blackstripe topminnow				⊗
Zygonectes olivaceus	Blackspotted topminnow				
Gambusia affinis	Mosquitofish	⊗		⊗	⊗
Menidia beryllina	Tidewater silverside		⊗	X	X

*For an explanation of terminology in table headings, see the appendix.

Table 46 (Cont'd)

Species	Common Name	Leon River	Belton Reservoir	Intermittent Creeks	Cowhouse Creek
Morone chrysops	White bass		0		
Lepomis auritus	Redbreast sunfish			X	X
Lepomis cyanellus	Green sunfish			(X)	(X)
Lepomis gulosus	Warmouth			X	
Lepomis humilis	Orangespotted sunfish			0	0
Lepomis macrochirus	Bluegill	(X)	(X)	(X)	(X)
Lepomis megalotis	Longear sunfish	0	0	(X)	0
Lepomis microlophus	Redear sunfish		X	(X)	X
Lepomis punctatus	Spotted sunfish	X		X	
Micropterus dolomieui	Smallmouth bass				
Micropterus punctulatus	Spotted bass			X	(X)
Micropterus salmoides	Largemouth bass	0	(X)	X	(X)
Micropterus sp.				0	
Micropterus treculi	Guadelupe bass				X
Poxomis annularis	White crappie	X	(X)		
Poxomis nigromaculatus	Black crappie				
Stizostedion vitreum	Walleye				
Etheostoma spectabile	Orangethroat darter			0	X
Percina caprodes	Logperch				X
Percina macrolepida	Big scale logperch				
Aplodinotus grunniens	Freshwater drum				
Cichlasoma cyanoguttatum	Rio Grand perch				
Mugil cephalus	Striped mullet				
Percinia sciera	Dusky oarter	0			X

Source: Hubbs (1976); Beaty (1978)

Comments:
X = Observed in Fall 1978
0 = Observed in Spring 1979
(X) = Observed in both Spring and Fall

Table 47

Results of Fish Collections--Fort Hood--Fall

Stations:	Belton Reservoir										Upper Leon River				
	B1					B3					R				
Taxa*	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)
Dorosoma cepedianum						7	124.3	17.8	0.1-43.5	22-137					
Dorosoma petenense															
Campostoma anomalum															
Notemigonus crysoleucas															
Notropia buchanani															
Notropis lutrensis	2	2.9	1.4	1.2-1.7	40-41										
Notropis venustus											6	5.7	1.0	0.4-1.6	31-41
Pimephales vigilax	10	4.6	0.5	0.1-0.9	18-39	20	38.1	1.9	0.8-2.8	36-57	2	4.1	2.1	1.9-2.2	46-49
Ictalurus melas															
Ictalurus natalis															
Ictalurus punctatus															
Zygonectes notatus															
Cambusia affinis															
Menidia beryllina	15	3.1	0.2	0.1-0.5	18-38	91	73.9	0.8	0.1-1.6	29-55	12	1.0	0.1	<0.1-0.1	10-21
Lepomis auritus															
Lepomis cyanellus															
Lepomis gulosus															
Lepomis macrochirus						1	3.4			50	84	17.3	0.2	<0.1-0.7	13-32
Lepomis megalotis															
Lepomis microlophus						3	5.7	1.7	1.6-2.0	38-43					
Lepomis punctatus											1				51
Micropterus punctulatus															
Micropterus salmoides															
Pomoxis annularis											1				72
Etheostoma spectabile															
Percina caprodes															
Total No.	27					122					106				
Total No. Taxa	3					5					6				

*For an explanation of terminology in table headings, see the appendix.

Table 47 (Cont'd)

Stations:	Upper Cowhouse Creek K					Mid Cowhouse Creek L					Lower Cowhouse Creek T				
Taxa	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)
Dorosoma cepedianum	1	6.5			86										
Dorosoma petenense											12	302.4	25.2	7.5-153.7	70-185
Campostoma anomalum											9	32.7	3.6	2.7-4.4	50-61
Notemigonus crysoleucas	5	1.6	0.3	0.3-1.6	34-61										
Notropia buchanani															
Notropia lutrensis															
Notropia venustus	143	106.5	0.7	<0.1-2.1	25-65	82	56.1	0.7	<0.1-2.8	23-69	33	38.7	1.2	0.3-2.5	24-46
Pimephales vigilax						12	9.3	0.8	<0.1-1.2	30-51					
Ictaluruo melas											5	4.5	0.9	0.4-1.8	24-45
Ictalurus natalis															
Ictalurus punctatus															
Zygonectes notatus															
Gambusia affinis	18	3.8	0.2	<0.1-0.8	19-36	140	86.4	0.6	<0.1-1.6	30-56	1	1.0			38
Menidia beryllina						411	125.7	0.3	<0.1-1.5	12-45	17	5.3	0.3	0.1-1.0	14-34
Lepomis auritus											157	183.3	1-2	0.3-2.0	23-55
Lepomis cyanellus						15	61.1	4.1	1.3-7.7	42-69					
Lepomis gulosus						24	66.1	2.7	1.2-5.5	42-64					
Lepomis macrochirus	5	3.5	0.7	<0.1-1.6	19-47	9	10.3	1.1	0.1-3.1	20-57	23	51.5	2.2	0.4-7.2	24-58
Lepomis megalotis															
Lepomis microlophus											4	23.6	5.9	3.7-10.1	48-67
Lepomis punctatus															
Micropterus punctulatus						1	0.5			78.1					
Micropterus salmoides	1	1.5			49.3										
Pomoxis annularis	2	16.1	8.1	6.5-9.6	83-96						7	78.2	11.2	4.6-30.7	57-113
Etheostoma spectabile	1	<0.1			28.2										
Percina caprodes											1	4.2			72
Total No.	176					694					269				
Total No. Taxa	8					8					11				

Table 47 (Cont'd)

Stations:	Mid Table Rock Creek O					Lower North Nolan Creek N1					Upper Clear Creek F				
Taxa	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)
Dorosoma cepedianum	16	145.4	9.1	6.5-14.3	86-114										
Dorosoma petenense															
Campostoma anomalum															
Notemigonus crysoleucas															
Notropis buchanani	9	3.8	0.4	0.2-0.5	29-43										
Notropis lutrensis															
Notropis venustus	147	76.5	0.5	0.1-1.2	22-50										
Pimephales vigilax	10	10.9	1.1	0.1-1.9	26-58										
Ictalurus melas															
Ictalurus natalis															
Ictalurus punctatus	5	1530.9	306.2	70.7-507	214-440										
Zygonectes notatus															
Gambusia affinis	5181	1073.0	0.2	<0.1-2.0	9.5-50	66	6.9	0.1	<0.1-0.1	11-24	215	70.0	0.3	<0.1-1.7	13-45
Menidia beryllina						1	0.1			23					
Lepomis auritus											4	32.7	8.2	6.5-9.8	54-63
Lepomis cyanellus	273	1961.3	7.2	0.3-75.0	27-153	1	0.2			20					
Lepomis gulosus						1	58.2			111					
Lepomis macrochirus	567	826.4	1.5	<0.1-116.1	15-172	31	207.9	6.7	<0.1-43.7	13-104	28	46.4	1.7	0.1-13.7	18-72
Lepomis megalotis	412	3202.6	7.8	0.3-87.6	29-185						1	29.0	29.0	29.0	87
Lepomis microlophus						1	59.7			115					
Lepomis punctatus						2	17.4	8.7	8.3-9.1	61	8	9.7	1.2	0.4-2.5	27-38
Micropterus punctulatus	13	385.4	29.6	3.4-26.0	60-179						2	5.9	2.9	2.5-3.4	43-54
Micropterus salmoides	12	2371.7	197.6	2.7-1221.3	62-267										
Pomoxis annularis															
Etheostoma spectabile															
Percina caprodes															
Total No.	**6645**					**103**					**258**				
Total No. Taxa	**11**					**7**					**6**				

Table 47 (Cont'd)

Stations:	Lower Clear Creek A					Reese Creek D					Lower Turkey Run Creek H				
Taxa	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)
Dorosoma cepedianum															
Dorosoma petenense															
Campostoma anomalum	6	21.8	3.6	3.4-4.6	54-59										
Notemigonus crysoleucas	16	214.5	13.4	5.9-20.0	66-91										
Notropis buchanani															
Notropis lutrensis	100	25.6	0.3	<0.1-1.3	18-40	1	4.7			70					
Notropis venustus	3	9.7	3.2	0.2-8.2	26-71	14	1.0	0.1	0.1-4.3	21-77					
Pimephalen vigilax	3	1.6	0.5	0.2-0.6	25-33										
Ictalurus melas	1	7.8			65										
Ictalurus natalis						1	1.5			48					
Ictalurus punctatus															
Zygonectes notatus															
Gambusia affinis	1622	444.3	0.3	<0.1-1.1	17-38	38	9.4	0.2	<0.1-0.7	18-40	182	39.3	0.2	0.1-2.0	12-45
Menidia beryllina															
Lepomis auritus															
Lepomis cyanellus	66	92.1	1.4	0.3-61.8	17-90	12	119.0	9.9	<0.1-64.8	14-134	266	247.8	0.9	0.4-74.0	22-119
Lepomis gulosus															
Lepomis macrochirus	33	22.8	0.7	0.1-2.0	17-37	19	84.1	4.4	<0.1-37.2	18.8-124	23	14.4	0.6	0.1-1.5	17-34
Lepomis megalotis	115	289.1	2.5	0.3-28.1	19-82						1	37.7			91
Lepomis microlophus															
Lepomis punctatus											57	107.7	1.9	0.4-2.8	28-45
Micropterus punctulatus															
Micropterus salmoides	1	54.9	54.9	54.9	126	1	10.2			93.5					
Pomoxis annularis															
Ethcostoma spectabile															
Percina caprodes															
Total No.	1966					86					529				
Total No. Taxa	11					7					5				

Table 47 (Cont'd)

Stations:	Upper House Creek I					Lower House Creek J				
Taxa	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)
Dorosoma cepedianum										
Dorosoma petenense										
Campostoma anomalum	2	4.0	2.0	1.5-2.5	45-52					
Notemigunus crysoleucas										
Notropis buchanani										
Notropis lutrensis	386	190.9	0.5	0.2-2.1	20-44	514	81.7	0.2	<0.1-1.2	18-44
Notropis venustus	1	0.3			25					
Pimephales vigilax	2	1.1	0.6	0.5-0.6	28-32					
Ictalurus melas										
Ictalurus natalis										
Ictalurus punctatus										
Zygonectes notatus										
Gambusia affinis	8	1.9		0.1-1.0	15-33	18	4.4	0.2	<0.1-0.6	13-38
Menidia beryllina										
Lepomis auritus										
Lepomis cyanellus	5	15.9	3.2	2.4-3.4	41-47	6	11.4	1.9	0.6-4.5	33-63
Lepomis gulosus										
Lepomis macrochirus						15	6.4	0.4	<0.1-1.5	14-45
Lepomis megalotis						7	173.6	24.8	11.2-33.7	81-115
Lepomis microlophus						3	6.3	2.1	1.2-2.6	32-44
Lepomis punctatus										
Micropterus punctulatus										
Micropterus salmoides										
Pomoxis annularis										
Etheostoma spectabile										
Percina caprodes										
Total No.	404					563				
Total No. Taxa	6					6				

Table 48

Results of Fish Collections[1] From Fort Hood--Spring

Stations:	Belton Reservoir									
	B1					B3				
Taxa*	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)
Lepisosteus osseus	11	10,319.1	938.1	567.0-1,360.8	592-740					
Dorosoma cepedianum	5	952.9	190.6	126.3-340.2	175-258	3	476.9	158.9	96.0-214.7	170-240
Dorosoma petenenae						1	26.3			99
Carpostoma anomalum										
Cyprinus carpio	1	2,513.2			445					
Notemigonus crysoleucas										
Notropia buchanani										
Notropia lutrensis										
Notropis venustus										
Pimephales vigilax						4	6.0	1.5	1.2-1.9	38-44
Ictiobus bubalus	2	4,989.5	2,494.8	1,360.8-3,628.7	390-493					
Ictalurus melas										
Ictalurus punctatus						3	2,758.3	914.4	600.3-1,402.9	330-440
Zygonectes notatus										
Gambusia affinis										
Menidia beryllina	1	2.4			62	4	7.7	1.9	1.0-3.4	43-68
Morone chrysops	1	283.2			235	2	1,154.7	577.4	558.1-596.6	300-310
Lepomis cyanellus										
Lepomis humilis										
Lepomis macrochirus	1	84.6			125	7	162.8	23.3	5.6-116.5	56-145
Lepomis megalotis						1	109.9			132
Lepomis microlophus										
Micropterus punctulatus										
Micropterus salmoides	1	143.7			185	1	60.3			138
Micropterus sp.										
Pomoxis annularis	5	837.2	167.4	71.9-453.6	139-240	1	10.7			79
Etheostoma spectabile										
Percina sciera										
Total No.	28					27				
Total No. Taxa	9					10				

*For an explanation of terminology in table headings, see the appendix.

[1]Fish collected by dip net, seine, electroshocker, and gill net.

Table 48 (Cont'd)

Stations:	Nolan Creek N2					Henson Creek Y				
Taxa	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)
Lepisosteus osseus										
Dorosoma cepedianum	2	179.6	89.8	80.7-98.9	161-167					
Dorosoma petenense										
Campostoma anomalum										
Cyprinus carpio										
Notemigonus crysoleucas										
Notropis buchanani										
Notropis lutrensis						218	180.4	0.8	0.5-3.0	28-48
Notropis venustus						2	6.8	3.4	3.3-3.5	53-83
Pimephales vigilax						21	30.2	1.4	0.7-3.2	35-52
Ictiobus bubalus										
Ictalurus melas										
Ictalurus punctatus										
Zygonectes notatus										
Gambusia affinis	15	8.8	0.6	<0.1-1.1	8-35					
Menidia beryllina										
Morone chrysops										
Lepomis cyanellus						2	4.2	2.1	1.5-2.7	35-42
Lepomis humilis						4	11.2	2.8	2.1-9.3	41-50
Lepomis macrochirus	5	117.0	23.4	6.8-37.2	51-96					
Lepomis megalotis										
Lepomis microlophus	2	204.5	102.2	56.5-148.0	113-150					
Micropterus punctulatus										
Micropterus salmoides										
Micropterus sp.										
Pomoxis annularis										
Etheostoma spectabile										
Percina sciera										
Total No.	24					247				
Total No. Taxa	4					5				

Table 48 (Cont'd)

Stations:	Upper Cowhouse Creek K					Mid Cowhouse Creek L					Turnover Creek P				
Taxa	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)
Lepisosteus osseus						2	1,933.7	966.8	790.0-1,143.7	590-670					
Dorosoma cepedianum															
Dorosoma petenense															
Campostoma anomalum															
Cyprinus carpio															
Notemigonus crysoleucas						1	18.3			97					
Notropis buchanani						53	39.5	0.74	0.6-1.0	31-38					
Notropis lutrensis						435	395.6	0.9	0.3-2.6	27-49	29	63.9	2.2	1.2-5.1	35-55
Notropis venustus	3	14.4	4.8	2.6-6.9	49-69	9	27.6	3.0	1.7-6.5	43-66					
Pimephales vigilax	1	0.9			37	17	32.5	1.9	0.9-4.6	38-62	2	0.2	0.1	0.1-0.1	18-19
Ictiobus bubalus															
Ictalurus melas															
Ictalurus punctatus	1	290.9			235										
Zygonectes notatus	1	0.7			35										
Gambusia affinis	32	18.3	0.6	0.1-1.6	20-38	4	2.9	0.7	0.2-1.3	27-39					
Menidia beryllina															
Morone chrysops															
Lepomis cyanellus	5	20.2	4.0	1.7-7.3	38-60						1	4.3			47
Lepomis humilis						4	18.6	4.6	3.8-5.2	49-53					
Lepomis macrochirus	6	29.1	4.8	1.0-9.0	32-64	1	2.4			44	2	4.6	2.3	2.2-2.4	38-42
Lepomis megalotis	9	73.3	8.1	3.1-26.4	45-87						1	5.9			69
Lepomis microlophus															
Micropterus punctulatus	1	11.4			83										
Micropterus salmoides											1	0.2			21
Micropterus sp.															
Pomoxis annularis															
Etheostoma spectabile															
Percina sciera															
Total No.	59					526					36				
Total No. Taxa	9					9					6				

Table 48 (Cont'd)

Stations:	Lower Clear Creek A					Reese Creek D					Lower Turkey Run Creek H				
Taxa	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)
Lepisosteus osseus															
Dorosoma cepedianum															
Dorosoma petenense															
Campostoma anomalum	5	1.0	0.2	0.1-0.3	18-24	3	0.5	0.17	0.1-0.3	16-28					
Cyprinus carpio															
Notemigonus crysoleucas	1	12.0			100										
Notropis buchanani															
Notropis lutrensis	21	34.7	1.6	0.2-3.0	23-50										
Notropis venustus	10	11.4	1.14	0.1-4.6	19-58										
Pimephales vigilax						14	65.0	4.6	3.0-6.2	51-69					
Ictiobus bubalus															
Ictalurus melas															
Ictalurus punctatus															
Zygonectes notatus															
Gambusia affinis	4	2.8	0.7	<0.1-1.2	8-35										
Menidia beryllina															
Morone chrysops															
Lepomis cyanellus	2	10.6	5.3	4.3-6.3	50-55										
Lepomis humilis															
Lepomis macrochirus											5	62.0	12.4	1.7-19.8	37-77
Lepomis megalotis	1	8.2			58										
Lepomis microlophus						2	144.1	72.1	19.1-125.0	78-124	2	15.3	7.6	3.1-12.2	46-67
Micropterus punctulatus											13	233.2	17.9	9.7-30.6	62-85
Micropterus salmoides															
Micropterus sp.															
Pomoxis annularis						204	12.1	0.06	<0.1-0.1	9-18					
Etheostoma spectabile															
Percina sciera						4	1.2	0.3	<0.1-1.0	14-40					
Total No.	44					227					20				
Total No. Taxa	7					5					3				

Table 48 (Cont'd)

Stations:	Upper Leon River R					Lower Leon River S				
Taxa	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)
Lepisosteus osseus										
Dorosoma cepedianum										
Dorosoma petenenae										
Carpostoma anomalum										
Cyprinus carpio										
Notemigonus crysoleucas										
Notropis buchanani										
Notropis lutrensis						62	36.3	0.59	0.1-3.3	22-51
Notropis venustus										
Pimephales vigilax						22	35.6	1.6	0.3-5.4	25-63
Ictiobus bubalus										
Ictalurus melas										
Ictalurus punctatus										
Zygonectes notatus										
Cambusia affinis						3	1.5	0.5	0.2-0.9	21-34
Menidia beryllina										
Morone chrysops										
Lepomis cyanellus										
Lepomis humilis										
Lepomis macrochirus	2	1.5	0.75	0.4-1.1	27-37	2	27.6	13.8	1.5-26.1	37-88
Lepomis megalotis						13	91.8	7.1	1.0-21.9	31-78
Lepomis microlophus										
Micropterus punctulatus										
Micropterus salmoides						1	18.3			90
Micropterus sp.										
Pomoxis annularis										
Etheostoma spectabile						1	3.5			65
Percina sciera										
Total No.	2					104				
Total No. Taxa	1					7				

Table 48 (Cont'd)

Stations:	Mid Table Rock Creek O					Lower Nolan Creek N1					Upper Clear Creek F				
Taxa	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)
Lepisosteus osseus															
Dorosoma cepedianum															
Dorosoma petenense															
Campostoma anomalum	9	4.8	0.5	0.1-1.0	21-37	1	0.2			19					
Cyprinus carpio															
Notemigonus crysoleucas															
Notropis buchanani															
Notropis lutrensis															
Notropis venustus	12	67.0	5.6	0.3-12.4	27-81										
Pimephales vigilax	25	3.8	0.15	0.1-0.4	16-30										
Ictiobus bubalus															
Ictalurus melas															
Ictalurus punctatus															
Zygonectes notatus															
Gambusia affinis	22	8.5	0.38	<0.1-1.5	8-39	65	21.9	0.34	<0.1-1.2	8-36					
Menidia beryllina															
Morone chrysops															
Lepomis cyanellus															
Lepomis humilus															
Lepomis macrochirus	2	6.0	3.0	2.6-3.4	43-46	4	3.1	0.77	0.1-2.5	18-42	2	28.2	14.1	1.1-27.1	34-86
Lepomis megalotis	29	398.2	13.7	5.7-32.0	51-89										
Lepomis microlophus															
Micropterus punctulatus															
Micropterus salmoides															
Micropterus sp.															
Pomoxis annularis															
Etheostoma spectabile	44	6.1	0.14	<0.1-0.1	14-24	1	0.2			22					
Percina sciera															
Total No.	143					71					2				
Total No. Taxa	7					4					1				

Table 48 (Cont'd)

Stations:	Upper House Creek I					Lower House Creek J					Owl Creek Z				
Taxa	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)	Total No.	Total Wt.(g)	Mean Wt.(g)	Wt. Range(g)	Length Range(mm)
Lepisosteus osseus															
Dorosoma cepedianum															
Dorsoma petenense															
Campostoma anomalum	1	<0.1			14										
Cyprinus carpio															
Notemigonus crysoleucas															
Notropis buchanani						2	6.7	3.3	2.3-4.4	57-65					
Notropis lutrensis	115	209.3	1.8	1.4-9.1	38-64	122	139.1	1.14	0.4-4.0	27-54					
Notropis venustus						1	3.6			57					
Pimephales vigilax															
Ictiobus bubalus															
Ictalurus melas															
Ictalurus punctatus						1	44.1			119					
Zygonectes notatus															
Gambusia affinis															
Menidia beryllina															
Morone chrysops															
Lepomis cyanellus															
Lepomis humilis						3	225.4	75.1	17.7-106.8	76-141					
Lepomis macrochirus						1	6.5			56					
Lepomis megalotis	1	14.1			66	15	70.8	4.7	1.9-8.3	39-60	1	4.7			49
Lepomis microlophus						1	20.0			77					
Micropterus punctulatus						1	29.5			91					
Micropterus salmoides															
Micropterus sp.															
Pomoxis annularis															
Etheostoma spectabile															
Percina sciera															
Total No.	117					147					1				
Total No. Taxa	3					9					1				

5 ECOLOGICALLY SENSITIVE AREAS

Terrestrial Areas

Terrestrial areas at Fort Hood which should be considered sensitive include mature Ashe juniper woodland, riparian woodland, and many of the small isolated springs which dot the area. Woodland containing mature Ashe juniper is essential habitat for the endangered (according to TOES) Golden-cheeked Warbler. Riparian woodland is important because it is relatively rare in the Fort Hood area. Its small, isolated springs are important as a source of fresh water for many species and as breeding habitat for others.

The riparian woodlands on the reservation are ecologically important as wildlife habitat, as corridors for migration through the extensive reservation, and as local reservoirs of plant and animal diversity. These woodlands harbor numerous eastern species which probably would not occur regularly at Fort Hood in the absence of such habitat. Riparian woodlands are probably no more sensitive to environmental perturbations than upland vegetation, but they are more worthy of preservation for the reasons noted above.

The eastern portion of Fort Hood, on either side of the Cowhouse Creek Arm of Lake Belton, is less disturbed than other parts of the reservation and generally provides better habitat for both plants and animals. The disjunct populations of big-tooth maple and white dog-tooth violet occur here, and portions of the area are recognized as prime habitat for the Golden-cheeked Warbler. The specific localities of the big-tooth maple and white dog-tooth violet populations are especially sensitive.

Aquatic Areas

The only aquatic area of the reservation which is particularly sensitive ecologically is the Cowhouse Creek area of Belton Lake. This area is important both as a recreational resource for fishing and other water-related activities and as a public water supply. Because of training activities at Fort Hood, this area is vulnerable to siltation. In addition to replacing the water volume with sediments, siltation tends to disrupt or otherwise restrict breeding of fish which prefer hard substrates. For example, many important game fish breed in gravel or sandy areas which can be eliminated by the settling of silt.

6 SUMMARY

Major components of Fort Hood's terrestrial and aquatic ecosystems were systematically sampled and analyzed. Studies of the terrestrial ecosystems included the delineation and characterization of vegetational communities, including quantification of vegetational components of representative communities and preparation of floristic species lists. In addition, representative communities were characterized according to their wildlife components. This included preparation of species lists for all terrestrial vertebrates and bird and mammal censuses in representative habitats. Representative aquatic communities were sampled for periphyton, phytoplankton, zooplankton, macrophytes, macroinvertebrates, and fish. Each aquatic system was characterized by species composition, density, and/or relative abundance.

The reservation is about 38 percent grassland and savanna, 57 percent woodland and scrub, and 5 percent built-up land. The woody vegetation of the reservation is primarily Ashe juniper (Juniperus ashei), live oak (Quercus fusiformis), and Texas oak (Q. texana). The grassland of the reservation includes elements of tall grass prairie, which is characteristic of the higher rainfall areas of the Blackland Prairie to the east, and the more important short-grass grasslands to the west.

Floristic surveys of Fort Hood revealed 380 species or varieties of plants representing 81 families. Two species of particular interest were the big-tooth maple (Acer Grandidentatum), and the white dog-tooth violet (Erythronium albidum).

Like the vegetation, the wildlife is typical of the Edwards Plateau. Qualitative and quantitative field surveys at Fort Hood revealed 28 species of amphibians and reptiles, 128 species of birds, and 20 species of mammals. The most notable bird species observed were the Roseate Spoonbill (Ajaia ajaja), the Osprey (Pandion haliaetus), and the Peregrine Falcon (Falco peregrinus).

Riparian woodland provides the best habitat for bird species diversity. Species diversity was lowest in the grazed grassland census area. Densities of birds were greatest in riparian woodland, followed by mixed woodland, juniper woodland, and grassland. The bird encountered over the widest portion of the survey area during the road-cruise censuses was the Cardinal (Cardinalis cardinalis).

Common mammal species observed on the reservation included the raccoon (Procyon lotor), white-tailed deer (Odocoileus virginianus), and black-tailed jack rabbit (Lepus californicus). Trapping indicated that the deer mouse (Peromyscus maniculatus) was the most common small mammal in the fall, and the Texas mouse (Peromyscus attwateri) and the White-ankled mouse (Peromyscus pectoralis) were most common in the spring.

Aquatic communities at Fort Hood were similar to those in other areas of Central Texas. Most of the stations sampled, other than those in Belton Lake, exhibited variable communities in terms of species compositions and densities. This was often the case in intermittent stream environments, where fluctuations in water level create pools or where floods drastically reduce resident populations and may considerably alter the physical habitat. During the fall

field surveys, most of the streams were not flowing, due to dry weather conditions in the area, thus creating a series of pools or ponds.

These communities were typical of those commonly observed in the calcareous streams of central Texas. Phytoplankton densities were lower in the spring; however, the diversity of diatoms increased due to scouring of the substrate by the spring rains.

Similar results were obtained in the zooplankton sampling program. The results of the phytoplankton, periphyton, and zooplankton surveys did not indicate any effects resulting from siltation directly. On the other hand, the indications of moderate, widespread enrichment observed may have been due, at least in part, to nutrients entering the streams along with soil particles. Zooplankton densities were generally lower in the spring.

Belton Lake had rather distinct phytoplankton and zooplankton assemblages during both surveys. This is the normal condition, considering the vast difference in habitat between the reservoir and its tributary streams.

Based on phytoplankton and zooplankton data collected from 7 to 11 May 1979, flood events at Fort Hood in spring 1979 appeared to have the greatest impact on the Leon River. Slower-moving, pool-like habitats, like those at Lower Cowhouse Creek and Belton Lake, appeared to be less affected by floods than some of the intermittent creeks where currents were faster and more scouring of substrates was likely to occur.

The macroinvertebrate survey showed that most stations were dominated by oligochaetes and dipterans. While this is often the case in enriched situations, these groups are also usually dominant in soft-sediment habitats. Doubtless, both conditions contributed to the large numbers and widespread occurrence of these organisms. The highest densities of organically enriched habitats were found at stations in Table Rock, House, and Cowhouse Creeks. All of these stations were characterized by thick layers of silty sediments over the original rocky stream beds. Densities were lower at most stations in the spring, although the silty substrate at Station J supported a more abundant oligochaete population, and total densities were higher at this station. Although Dipterans were still an important group in terms of abundance, they were considerably less abundant and diverse in benthic samples than they were in the fall. However, quantitative and qualitative analyses of samples indicated that the numbers of taxa observed were not excessively low, nor were individual species densities high enough to indicate a heavily polluted situation.

The results of both fish collections, both in the streams sampled and in Belton Lake, do not indicate any conditions that would be considered unusual in the types of habitat sampled. Members of the families Cyprinidae (minnows) and Centrarchidae (sunfishes) were the most commonly collected.

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APPENDIX: METHODS

Vegetation

Quantitative vegetational surveys and qualitative floristic surveys were conducted at the Fort Hood Military Reservation in 1978 between 11 and 15 September and 19 and 24 September. In addition, a ground reconnaissance was performed on 9 and 10 August 1978, and an aerial reconnaissance was performed on 29 September 1978. The spring vegetative study was conducted between 22 May and 27 May 1979 using the same methods as the previous fall. The urban environment was not studied in detail because its composition is under human control and is altered with little regard to normal ecological principles.

Vegetation Mapping Methods

The generalized vegetation map of Fort Hood Military Reservation (Figure 2) was based on terrain analysis maps prepared by the U.S. Army Engineer Topographic Laboratory in 1977. The original terrain analysis delineated 15 categories on the basis of vegetational physiognomy, which included four categories of coniferous woodland and scrub, four of mixed woodland and scrub, four of deciduous woodland and scrub, two of grassland, and one in which vegetation was not a significant factor. The map was prepared by eliminating parcels which were too small to be portrayed effectively at the small scale necessary for this report. In some cases, physiognomic categories were combined when field studies failed to reveal a useful vegetational distinction among them.

Plant Community Survey Methods

The vegetation at Fort Hood was surveyed and sampled to describe the plant communities in terms of areal extent and composition by dominant and characteristic species. Seventeen stands of vegetation were selected as being representative of the reservation's plant communities.

Quantitative samples were obtained in selected woodland stands, using the point-centered quarter method of Cottam and Curtis.[76] The quarter method involves measuring the distance from an arbitrarily selected point to the nearest tree in each of the four 90-degree quadrants and measuring and recording the tree's diameter at breast height (dbh) and its scientific name. The average point-to-tree distance is squared to compute the mean area for individual trees in the stand. The parameters sampled by the point-centered quarter method are density, basal area, and frequency of tree species. The following definitions pertain to the quarter method.

Mean Area is the square of the average point-to-tree distance. It designates the space occupied by an average tree.

Density is the number of trees per unit area.

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[76] G. Cottom and J. T. Curtis, "The Use of Distance Measures in Phytosociological Sampling," Ecol., No 37 (1956), pp 450-460.

Frequency of a species is the percentage of quarter points at which that species is sampled.

Mean Basal Area is the average cross-sectional area of the trunk of a tree species measured at 1.5 m.

Total Basal Area of a species is the product of the species' density and its mean basal area.

Relative Density is the number of sampled trees of a species divided by the total number of trees sampled. % Relative Density = Relative Density x 100.

Relative Frequency of a species is the frequency of that species divided by the sum of frequency values for all species. % Relative Frequency = Relative Frequency x 100.

Relative Basal Area is the total basal area of a species divided by the sum of the total basal area for all species.

Important Percentage is the average of % relative values (frequency, density, and basal area) for a species.

In the present study, 10 to 15 points (40 to 60 trees) were sampled in each stand. Points were selected at 20-m intervals throughout the stands. Tree diameters at 1.5 m (dbh) were measured with a diameter tape. In each stand, observations were made at frequent intervals to determine the shrub and ground-cover components of the stand. Qualitative observations on species composition were also made in a number of stands which were not sampled by the quarter method or other quantitative means. Taxonomic names follow Correll and Johnston.[77]

Terrestrial Wildlife

Quantitative and/or qualitative surveys of amphibians, reptiles, birds, and mammals of the Fort Hood Military Reservation were conducted during 21 through 25 August 1978 and from 28 August through 1 September 1978. In addition, visits were made to Fort Hood on 9 and 10 August and on 11 and 12 September. The spring wildlife survey was conducted between 22 April and 3 May 1979. The urban environment was not surveyed in detail because normal ecological principles do not maintain their complete integrity in urban systems, and there was not fall data to use for comparison.

Amphibians and Reptiles

There is no acceptable technique for quantifying amphibian and reptile populations without extensive mark-recapture techniques, and these are of questionable value. Therefore, qualitative amphibian and reptile surveys were performed daily by general field reconnaissance and observation within the

[77] D. Correll and M. Johnston, Manual of the Vascular Plants of Texas (Texas Research Foundation, Renner, 1970).

boundaries of the Fort Hood Military Reservation. Rocks, logs, and associated debris were overturned in search of organisms; vocally active species were identified by their calls in late evening and after rains, and roads were driven at night in search of nocturnal species. Captured and/or observed specimens were identified using Blair, et al.,[78] Ernst and Barbour,[79] and Conant.[80] Nomenclature follows Collins, et al.[81]

Birds

Birds were observed daily in various habitats within the project area. Habitats used and relative abundance were recorded for each species.

Quantitative estimations of small bird densities were determined by walking five Emlen[82] type transects as follows: one 1500-m transect in grazed grassland; one 300-m transect in mixed juniper-deciduous forest; one 500-m transect in a burned disturbed woodland; one 900-m transect (in two segments) in riparian woodland; and one 1150-m transect in juniper woodland. Figure 6 shows the locations of these transects. Emlen and other closely related transects are considered the most appropriate for natural resource inventories calling for density estimates of bird species in an area throughout the year.[83] Field procedures and subsequent data interpretation followed the methods described by Emlen[84] for estimating bird densities during the nonbreeding season, except that a minimum specific strip of 30 m was used to avoid artificially high estimates of birds observed in low numbers adjacent to the trail. Balph, et al.,[85] describes a method of analyzing transect data in this manner. The mean of the repetitions of each transect was used to compute densities as suggested by Emlen.[86] Emlen transects are inappropriate for estimating densities of large wide-ranging species;[87] therefore, birds such as vultures and hawks were excluded from the density estimates. The results of

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78 W. F. Blair, A. P. Blair, P. Brodkorb, F. K. Cagle, and G. A. Moore, Vertebrates of the United States (McGraw-Hill Book Co., Inc., 1968).

79 C. H. Ernst and R. W. Barbour, Turtles of the United States (Univ. Press of Kentucky, Lexington, 1972).

80 R. Conant A Field Guide to Reptiles and Amphibians of Eastern and Central North America, 2nd ed. (Houghton Mifflin Co., 1975).

81 J. T. Collins, J. F. Huheey, J. L. Knight, and H. M. Smith, Standard Common and Current Scientific Names for North American Amphibians and Reptiles, Misc. Publ. Cir. No. 7 (SSAR, 1978).

82 J. T. Emlen, "Population Densities of Birds Derived From Transect Counts," Auk, No. 88 (1971), pp 323-342.

83 M. H. Balph, L. C. Stoddart, and D. F. Balph, "A Simple Technique for Analyzing Bird Transect Counts," Auk, No. 88 (1977), pp 606-607.

84 J. T. Emlen, "Population Densities of Birds Derived From Transect Counts," Auk, No. 88 (1971), pp 323-342.

85 M. H. Balph, L. C. Stoddart, and D. F. Balph, "A Simple Technique for Analyzing Bird Transect Counts," Auk, No. 88 (1977), pp 606-607.

86 Emlen, et al., 1971.

87 Emlen, et al., 1971.

each transact were evaluated and compared using Whittaker's[88] index of species diversity/richness as follows:

d = S/log A, where

S = number of species, and

A = area sampled (in square meters)

In addition to the Emlen transects in specific habitat types, two 25-mi quantitative road-cruise bird censuses were conducted. Each census route transversed a variety of habitats. The transects were started at sunrise and all birds seen or heard during a three-minute period at each of 50 stops (1/2 mi apart) were recorded. Results are presented as number of birds observed per mile of transect. Figure 6 shows the road-cruise census routes.

Bird identification during the surveys was facilitated by using Peterson[89] and Robbins, et al.[90] Nomenclature is according to the American Ornithologists' Union.[91]

Mammals

Mammals were surveyed on Fort Hood either by direct observation, detection of tracks, scat or nests, and/or capture.

Small mammals were censused using 3 x 3 x 9-in. Sherman live traps. Trap lines consisting of a variable number of trap stations, each separated by approximately 10 to 25 m, were established in the following habitats: grazed grassland, ungrazed grassland, mixed juniper-deciduous woodland, burned disturbed woodland, juniper woodland, riparian woodland, and a fenced food plot. Traps were baited with rolled oats, and each line was run a maximum of four consecutive nights. Data for 1080 trap-nights were collected and results expressed as trap-night ratios and percent success. Figure 6 shows the trapping locations.

A 64-km spotlight road-cruise mammal census was conducted on 30 August. A speed of about 10 mph was maintained except when closer observation required temporary stops. All species observed and the numbers of each were recorded. Results are presented as number of mammals per mile. Figure 6 shows the census route.

Additional information concerning game species was obtained from the Fish and Wildlife Section at Fort Hood.

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88 R. H. Whittaker, Communities and Ecosystems, 2nd ed. (Macmillan Publishing Co., 1975).

89 R. T. Peterson, A Field Guide to the Birds of Texas (Houghton-Mifflin Co., Boston, 1963).

90 C. S. Robbins, B. Brunn, and H. S. Zim, A Guide to Field Identification: Birds of North America (Golden Press, 1966).

91 C. S. Robbins, B. Brunn, and H. S. Zim, A Guide to Field Identification: Birds of North America (Golden Press, 1966).

Identifications of specimens were based on Davis[92] Blair, et al.,[93] and Lowery.[94] Nomenclature follows Jones, et al.[95]

Aquatic Communities

The aquatic communities at Fort Hood were characterized according to water quality, phytoplankton, periphyton, zooplankton, macroinvertebrates, and fish. Collections for each of the organism groups were made at 14 stations between 21 and 25 August 1978. In addition, a ground reconnaissance was performed on 9 and 10 August 1978. A spring survey of 17 stations was conducted between 7 and 11 May 1979.

Water Quality

Physical-chemical parameters collected in aquatic habitats at Fort Hood include dissolved oxygen (DO) and temperature, using a YSI Model 51A DO meter; specific conductance, using a YSI Model 33 salinity-conductivity-temperature meter; pH, using a Leeds and Northrup Model 7417 portable pH meter; and light penetration, using a 20.32 cm black-and-white secchi disk. The spring survey used a Horiba Model 4-7 water quality checker to measure pH, temperature, conductivity, turbidity, and DO. The turbidity readings were discarded due to calibration problems. The parameters were measured in the field at the time of biological sampling.

Phytoplankton

Phytoplankton was collected by taking duplicate 1-liter grab samples from undisturbed areas at each station. Phytoplankton samples were preserved by adding of M-3 at a final concentration of 3 percent. Each replica was concentrated to 50 m by settling. Phytoplankton organisms were identified and enumerated at 400x magnification using a counting chamber similar to that described by Palmer and Maloney.[96] The results are expressed as density (no./ml) of each species averaged over the two replica samples. Taxonomic

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92 W. B. Davis, The Mammals of Texas, Texas Parks and Wildlife Department Bull. 41, Austin (1974).

93 Blair, et al., 1968.

94 G. H. Lowery, Louisiana Birds (Louisiana State Univ. Press, Baton Rouge, 1974).

95 Jones, et al., 1973.

96 C. M. Palmer and T. E. Maloney, "A New Counting Slide for Nannoplankton," Limnol. and Oceanogr., Spec. Publ. 21 (1954), pp 1-6.

sources used include Patrick and Reimer,[97] Boyer,[98] Hustedt,[99] U.S. Department of the Interior,[100] Prescott,[101] and Smith.[102]

Periphyton

Periphyton samples were obtained by collecting one or more examples of common substrates at each station. These were placed in clean sample containers, preserved with formalin, and returned to the lab for analysis. The substrates were scraped and the resulting assemblage was treated with hydrogen peroxide and potassium dichromate to prepare the diatoms for identification. The cleaned diatoms were mounted in Hyrax- and enumerated (strip count) at 1000x magnification until at least 200 individuals were encountered. The results for each station are expressed as the relative abundance (percent) of each species. Taxonomic sources were the same as those used for phytoplankton.

Zooplankton

At most stations in the fall and at all stations in the spring, zooplankton samples were composites of eight 5-liter grab samples poured through a No. 25 mesh (64 microns) plankton net with a Wisconsin bucket. In some cases in the fall (Stations R - Upper Leon River, N1 - Lower Nolan Creek, N2 - Lower Nolan Creek), the above method was not feasible and a 1-gal grab sample was obtained instead. Samples were preserved by adding formalin to yield a final concentration of 10 percent. In the lab, samples were diluted to appropriate volumes for counting. Using Sedgwick-Rafter cells, at least 200 individuals, or five slides, were counted. Rotifers, cladocerans, and adult copepods were identified to species when possible. Immature copepods were identified as calanoid, cyclopoid, or nauplii. Results are reported as number per liter.

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Taxonomic sources used include Ahlstrom,[103] Edmondson,[104] Chengalath and Mulamoottil,[105] and Ruttner-Kolisko.[106]

Macroinvertebrates

Composite quantitative macroinvertebrate samples were collected, using a 15.24- x 15.24-cm Ekman dredge where substrates were silt, detritus, or fine gravel. In sand or gravel riffles, a 30.48- x 30.48-cm Surber sampler was used. Quantitative samples were not collected where bottom substrates were rock. In Belton Lake, three dredge hauls were composited at each station. At other stations, two quantitative samples were composited. Samples were washed in the field, using a 30-mesh sieve bucket. Qualitative macroinvertebrate samples were collected in all available habitats at each creek station, using a 30-mesh dip net. A standard sampling effort of about 20 minutes per station was expended. Organisms picked from rocks and woody debris were included in dip net samples. All macroinvertebrate samples were preserved in 70 percent formalin (final concentration) and returned to the laboratory for analysis.

In the laboratory, samples were washed in a 30-mesh screen to remove formalin. Dredge samples containing large amounts of detritus were split into portions and a representative subsample, usually one-fourth to one-half, was picked. Techniques used to facilitate picking samples include staining with rose bengal and sucrose flotation.[107] Organisms were placed in vials with 70 percent alcohol/5 percent glycerin as preservative. When feasible, species were identified using an Olympus SZIII or a Bausch and Lomb Stereo Zoom 7 dissecting microscope. Diptera and Oligochaetes were mounted in Berlese's mounting medium[108] and identified with the aid of an Olympus KHC compound microscope. Raw counts for Ekman and Surber samples were converted to density estimates, or average number per meter for two or three replica.

Species diversity of the benthic community was calculated from Ekman and Surber density estimates by the equation of Wilhm and Dorris[109] using natural logarithms:

$$\bar{d} = -\Sigma(ni/n) \ln (ni/n)$$

where ni = the number of individuals of the ith species
n = total number of individuals in the sample.

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Taxonomic references used include Edmondson,[110] Mason,[111] Roback,[112] Johannsen,[113] Hamilton,[114] Brinkhurst,[115] U.S. Environmental Protection Agency[116] and Pennak.[117]

Fish

Several gear types were used to collect fish at Fort Hood. Seine samples were taken with a 6.10- x 1.22-m x 0.64-cm minnow seine at 12 creek stations and two lake stations. When possible, an area of 185 m was sampled at each station. In conjunction with the seine hauls, additional sampling was done with a 0.64-cm mesh dip net. Gill net collections were made, using a 45.72-m experimental gill net. These nets are divided into six sections of different mesh sizes: 2.5 cm, 3.8 cm, 5.0 cm, 6.3 cm, 7.5 cm, and 8.9 cm. Two nets were placed at Station B2 for one night and at Station B4 the following night. Electrofishing with a 4-kw generator was used at all four stations in Belton Lake, and the catch was composited into two total samples: B1 with B2, and B3 with B4. Each sample represented a total of 45 minutes of shocking, with a concentration of effort on shoreline and brushy areas.

Fish collected by seine were sorted in the field, preserved in formalin, and returned to the laboratory for analysis. Fish collected by gill netting and electroshocking were analyzed in the field. Data collected for seine samples included species, total number and weight, average and range of weight, and standard length range. Fish collected by gill netting and electroshocking were identified, measured, and weighed.

Taxonomic references include Blair, et al.,[118] Pflieger,[119] Hubbs,[120] and Bailey.[121]

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